Glennallen to Palmer Spur Line

Engineering Report

Prepared for:

Alaska Natural Gas Development Authority

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Section 1. Executive Summary

Michael Baker Jr., Inc (Baker) was retained by the Alaska Natural Gas Development Authority (ANGDA) to prepare a "conditional use" right-of-way lease application for submittal to the State of Alaska for a natural gas spur pipeline between Glennallen and Palmer. This report presents information compiled by various entities contracted by ANGDA in support of the lease application. These support efforts were divided into the following areas:

- Engineering
- Environmental
- Land Alignment
- Public Outreach

A conceptual report that presented a baseline pipeline alignment, and several alternative routes, for the project was completed in September 2004 (ANGDA 2004a). The conceptual baseline route followed the Glenn Highway right-of-way from Glennallen to Palmer. The alternative routes provided options deviating from the highway right-of-way. The baseline and alternative routes are summarized in Section 3 of this report.

Based on information provided by the various supporting companies, and with direction from ANGDA, a final route was selected for permitting. Section 4 presents a proposed route summary, and a brief synopsis of climate, physical environment, landowners, and other issues related to the route.

Environmental aspects for the project are discussed in Section 5. Available information is summarized; however, the information is limited and will require further studies during subsequent phases of the project to properly address the environmental issues related to the project. A total of 81 stream crossings are anticipated for the project, all of which may be classified as minor stream crossings. It is estimated that bored crossings will be required at approximately 11 of the streams. The remaining 70 streams may be crossed using open trenching construction techniques. However, it is expected that some of the streams will require that these techniques be performed during winter months to minimize erosion, sedimentation, and impacts to fish habitat. A minimal number of crossings of streams containing fish will be encountered.

Section 6 provides a brief summary of information collected during public outreach meetings and interviews. The audience targeted at these meetings was intended to represent the "opinion leaders" of the communities adjacent to the project. The purpose of the interviews was to heighten public awareness and knowledge of the project, and to solicit constructive feedback from the community. A summary of the most commonly asked questions is also listed in this section.

A conceptual pipeline design was developed based on information currently available regarding the project. However, as project definition progresses and more information is made available, the corresponding design will evolve. Section 7 presents criteria applicable to the final design of the spur line, and discusses a few of the basic pipeline issues that must be properly addressed during design.

Typical construction mode and techniques anticipated for the spur line project are discussed in Section 8. The conceptual design for the spur line is based on conventional burial for the vast majority of the project; however, at some river and stream crossings, as well as highway crossings non-conventional installation techniques such as horizontal directional drilling (HDD) and boring will likely be required. In addition, depending upon results of future studies of the fault lines crossed by the alignment, relatively short stretches of aboveground construction or special ditch design may be required.

Based on the conceptual alignment and design information, a cost estimate, schedule, and material list were compiled for the project and are summarized in Section 9. Layout of the schedule assumes the best-case scenario with project construction beginning in the fall of 2006. The cost estimate that has been included is considered a Budget "Level 0" Estimate with an accuracy of ±30% and does not include construction camps for the project. The camps have been excluded based on the assumption that the workforce will reside within busing distance of the project during construction. Temporary maintenance camps have been included in this estimate. The estimate of all construction costs is approximately $362 million, expressed in year 2005 dollars. Table 1.1 provides a breakdown of the project costs.

Table 1.1: Abbreviated Construction Cost Summary

Description	Cost (X 1000)
Total Pipeline Contractor Cost - Summer	$80,046
Total Pipeline Contractor Cost - Winter	$74,862
Total Material Costs	$126,171
Total Miscellaneous Costs	$28,511
Total Project Indirect Costs	$52,169
Total Pipeline Costs	**$361,758**

The assumptions used in compiling the estimate are summarized in the section. In addition, Section 9 also includes the results of a brief study to identify potential mineral material sources and is discussed with potential sites presented in tabular form.

Section 10 briefly outlines requirements for quality control, inspection, and testing plans that will need to be developed and implemented prior to the start of construction. These plans are parts of the overall quality assurance program for the project.

A brief discussion of the financing requirements for this project is given in Section 11. The information presented is a summary of the discussion regarding issuance of tax-exempt bonds to fund the spur line project presented in an earlier ANGDA report (ANGDA 2004b).

The main purpose of this report is to provide support for the lease application. Though insufficient information is available to apply for the final application, adequate detail does exist that allows the submittal of a "conditional use" right-of-way lease application. Future work efforts (e.g., field studies, aerial photography evaluation, geotechnical investigations, etc.) are required to advance the design sufficiently to allow the final right-of-way lease application to be completed and a permanent right-of-way lease to be issued by the State of Alaska.

Section 2. Acronyms

AAC	Alaska Administrative Code
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation and Public Facilities
ALA	American Lifelines Alliance
ANGDA	Alaska Natural Gas Development Authority
ANSI	American National Standards Institute
API	American Petroleum Institute
ARRC	Alaska Railroad Corporation
AS	Alaska Statutes
ASME	American Society of Mechanical Engineers
BLM	Bureau of Land Management
BMP	Best Management Plan
CFR	Code of Federal Regulations
CP	Cathodic protection
DMLW	Division of Mining, Lands & Water
DOC	Depth of Cover
DO&G	Division of Oil and Gas
EPA	Environmental Protection Agency
FAQ	Frequently Asked Questions
FBE	Fusion bonded epoxy
HDD	Horizontal directional drilling
IRS	Internal Revenue Service
MAOP	Maximum Allowable Operating Pressure
MP	Milepost
NDE	Nondestructive Examination
NFS	Non-frost susceptible
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetlands Inventory
OHMP	Office of Habitat Management and Permitting

Psi	Pounds per square inch
QA	Quality assurance
SHPO	State Historic Preservation Officer
SWPPP	Storm Water Pollution Prevention Plan
TAPS	Trans Alaska Pipeline System
U.O.N.	Unless otherwise noted
USFWS	United States Fish and Wildlife Service
USC	United States Code
USGS	United States Geological Survey
UT	Ultrasonic Testing

Section 3. Introduction

This report provides documentation supporting the submittal of a “conditional use” right-of-way lease application to the State of Alaska for a natural gas spur pipeline between Glennallen and Palmer.

While presenting a comprehensive summary of information pertinent to the application submittal, this document primarily discusses the engineering aspect. Portions relating to environmental, land alignment, or public outreach are simply summaries of other reports that were assembled for this project. The intent of this report is to provide a clear understanding of the project specifics as necessary to support the right-of-way lease application submittal.

3.1. Project History

The ANGDA spur line project began in 2004 and several reports were released documenting various aspects of the project. These reports were:

- *24-Inch Spur Line from Glennallen to Palmer – Conceptual Alignment and Budget Level Cost Estimate* (ANGDA 2004a). This report identified a baseline route, and alternative routes, for the spur line. The baseline route was used for the original cost estimate.
- *Financial Plan for the Cook Inlet Spurline* (ANGDA 2004b). This report presents a financing plan for the construction of the pipeline was finished.
- *Spurline Report on Utility Regulation* (ANGDA 2004c). This report defines the Regulatory Commission of Alaska (RCA) issues related to ANGDA’s role as a gas transportation utility and supplier of gas to utilities serving intrastate users was completed.
- *Right-of-Way and Permitting Issues* (ANGDA 2004d). This report addresses the right-of-way and permitting issues, environmental standards, mitigation, and best practice issues for the spur line project.

These reports are available to the public on the ANGDA website, http://www.allalaskalng.com/spurline.html.

3.2. Location

The project extends from Glennallen to Palmer and is located between longitudes 149° 18’ W and 145° 30’W, and latitudes 61°33’N and 62°9’N. Communities near the pipeline right-of-way corridor include Glennallen, Chickaloon, Sutton, and Palmer. Figure 3.1 identifies the project location.

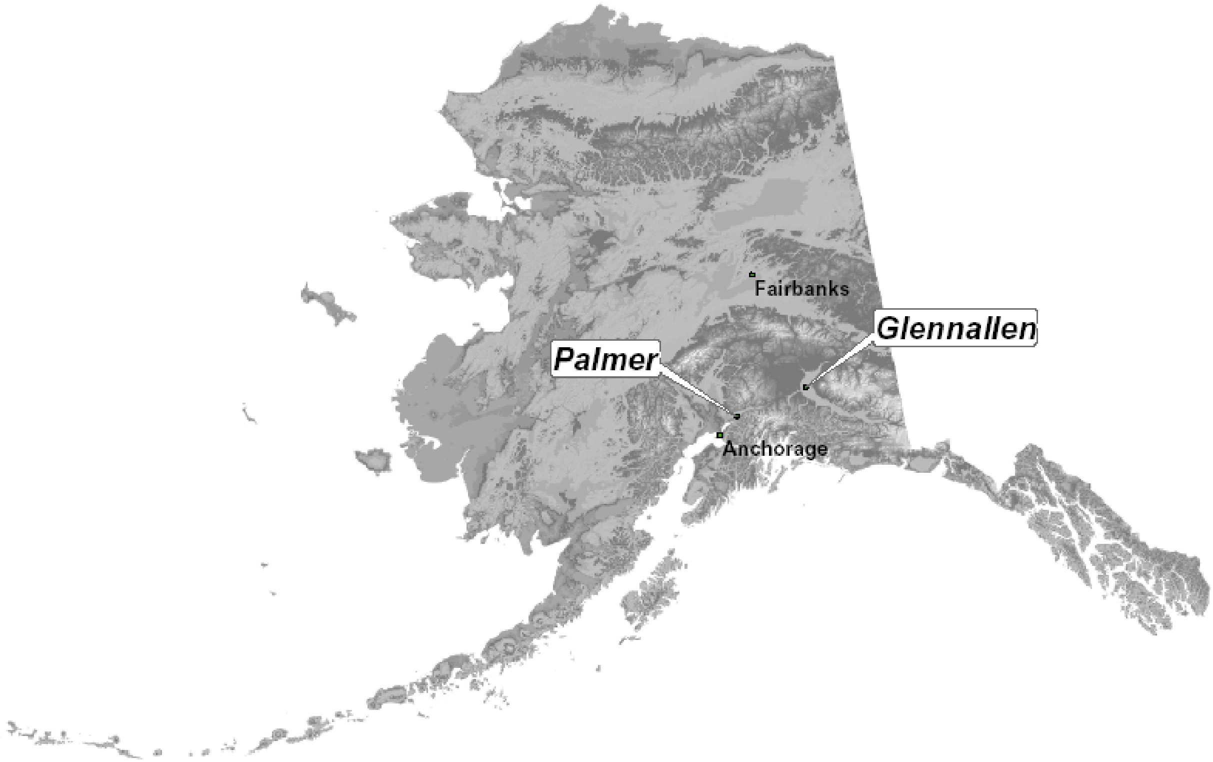

Figure 3.1: Location Map

3.3. Pipeline Route Summary

During the ANGDA conceptual study of the Glennallen to Palmer spur line (ANGDA, 2004a) a baseline alignment of the pipeline was established. In addition, four alternate routes at locations along the baseline alignment were also identified. The final route for the spur line was selected from the baseline route and the alternatives, and is discussed later in Section 4.

The composition of the gas that will enter the spur line in Glennallen is unknown. A gas processing plant may be required near Glennallen to generate a utility grade feed to the spur line, provide utility gas for use in Glennallen or produce propane for market in the Glennallen area. Depending upon the final gas composition and desired facility configuration, there is the potential for facilities of some nature being required near both the origin (Glennallen) and terminus (Palmer) of the spur line.

Baseline Route Description

The baseline route, as defined in the conceptual study, begins at the intersection of the right-of-way for the Trans-Alaska Pipeline System (TAPS) and the Alaska Department of Transportation and Public Facilities (ADOT&PF) Glenn Highway right-of-way within the town of Glennallen. Routing along the ADOT&PF right-of-way through Glennallen crosses numerous improved and unimproved roads, utilities and other infrastructure typically found in areas of relatively high population density.

Once beyond Glennallen the route encounters the Tolsona Creek drainage. A campground and other infrastructure exist at Tolsona Creek immediately adjacent to the highway. The alignment then follows the ADOT&PF right-of-way from Tolsona Creek to the Little Nelchina River. The conceptual alignment follows the ADOT&PF right-of-way across the Little Nelchina River.

After the Little Nelchina, the route continues west within the ADOT&PF right-of-way. United States Geological Survey (USGS) data shows that soil with underlying permafrost ends slightly east of the Sheep Mountain Lodge. A summer construction mode has been chosen from this location to the pipeline terminus southwest of Palmer. The alignment follows along the ADOT&PF right-of-way down a gradual slope past Gunsight Mountain to the Caribou Creek crossing.

The Glenn Highway near Caribou Creek follows the contour of the drainage ravine and crosses the creek about a mile and a half upstream of the confluence of the creek and the Matanuska River. The highway through this area is narrow and cut into a steep cross slope thereby making pipeline construction within the ADOT&PF right-of-way impractical. The baseline route deviates from the ADOT&PF right-of-way and crosses Caribou Creek approximately three-quarters of a mile upstream of the confluence of the creek with the Matanuska River. The alignment departs the ADOT&PF right-of-way, proceeds directly down slope to Caribou Creek, crosses the creek, proceeds up the other side, and then re-enters the ADOT&PF right-of-way.

Lions Head, just west of the Caribou Creek drainage, marks the beginning of the Matanuska River Valley. The conceptual alignment follows the ADOT&PF right-of-way along the north side of the Matanuska River Valley from Lions Head to Long Lake. Due to close proximity with the Matanuska River, portions of the alignment along the highway right-of-way in this section may require future investigations to determine a more optimum route.

The Glenn Highway to the north of Long Lake is narrow and cut into a steep cross slope thereby making construction of the spur line in the ADOT&PF right-of-way impractical in this area. Therefore, the baseline alignment deviates from the ADOT&PF right-of-way and follows a small ridge to south of the lake. The alignment then parallels a trail along the south side of the lake until re-entering the ADOT&PF right-of-way just west of the Long Lake.

The ADOT&PF right-of-way immediately west of Long Lake is routed along a narrow cut into a steep north facing cross slope making construction through this area very difficult. It is likely that future field reconnaissance will yield a better route through this area. Pending such field reconnaissance, the baseline alignment is routed along the ADOT&PF right-of-way from Long Lake to just east of Chickaloon.

The Glenn Highway drops down to the edge of the Matanuska River in the Chickaloon area and then generally follows the river for a number of miles. Numerous sharp turns, a narrow roadbed, and cliffs on the roadside opposite of the river characterize the Glenn Highway immediately next to the Matanuska River in this area. The ADOT&PF right-of-way has steep cross slopes in many areas where it meanders away from the Matanuska River. Construction through this area is considered as prohibitively complicated and thus the alignment is routed away from the ADOT&PF right-of-way for approximately 13-miles.

The alignment leaves the ADOT&PF right-of-way east of Chickaloon and crosses the Chickaloon River about one-mile upstream of its confluence with the Matanuska River. The alignment parallels an unimproved road for a brief distance and then proceeds northwest to an elevation of approximately 1300-feet. The alignment then generally follows the 1300-foot contour westward staying uphill of a couple small lakes. The alignment crosses the Kings River and then runs parallel to a trail until it re-enters the ADOT&PF right-of-way near the confluence of the Kings and Matanuska Rivers.

The baseline alignment then follows the ADOT&PF right-of-way for a short distance from near the confluence of the Kings River and Matanuska River to approximately one mile east of Granite Creek. After this the route veers to the north of Sutton and the Palmer State Correctional Center. The alignment crosses Moose Creek approximately 1.5-miles upstream from the confluence with the Matanuska River. The route follows Moose Creek Road for approximately 0.5-miles and reenters the ADOT&PF right-of-way near the intersection of the Moose Creek Road and Glenn Highway.

The baseline alignment follows the ADOT&PF Glenn Highway right-of-way from Moose Creek through Palmer to the intersection of the highway and the right-of-way of the Alaska Railroad near the south edge of Palmer. The alignment then follows the Alaska Railroad right-of-way to the area immediately south of the intersection with the Parks Highway.

The composition of the natural gas flow through the spur line has not been determined. A rich gas composition will require that processing of the gas remove a portion of the non-methane compounds (e.g. ethane, propane, butane) to produce a utility grade gas prior to delivery to ENSTAR Natural Gas Company's (ENSTAR) transmission system. A potentially favorable location for a gas processing plant is near the baseline alignment south of Palmer due to its close proximity to both the Alaska Railroad and Glenn Highway infrastructure.

The Alaska Railroad crosses under the new Glenn Highway via a narrow tunnel. It is assumed that the spur line would not share this tunnel with the railroad. The conceptual alignment leaves the Alaska Railroad right-of-way just prior to the Glenn Highway and proceeds straight to the tie-in with ENSTAR's 20-inch pipeline on the west side of the Glenn Highway.

Baseline Route – Alternative 1

Alternative 1 begins on the TAPS right-of-way approximately 3.5-miles north of Glennallen and proceeds southwest until it intersects with the ADOT&PF right-of-way west of Glennallen. The Alternate 1 alignment provides for a possible gas processing plant north of Glennallen and avoids routing the spur line through the town of Glennallen.

Baseline Route – Alternative 2

Alternative 2 begins at the ADOT&PF right-of-way for the Glenn Highway a few miles west of the Eureka Roadhouse and proceeds up the Squaw Creek and Caribou Creek drainages to Chitna Pass. Alternative 2 then follows the Boulder Creek down slope to the Chickaloon area.

Alternative 2 reflects a major departure from the ADOT&PF right-of-way that would bypass approximately 47-miles of the current baseline conceptual alignment through the Matanuska River Valley. Alternative 2 avoids a potentially complicated crossing of the Caribou Creek near the confluence with the Matanuska River. Alternative 2 also avoids construction in areas where the ADOT&PF right-of-way is in close proximity to the Matanuska River.

Baseline Route – Alternative 3

Alternative 3 reflects the probable alignment should field reconnaissance show that the pipeline can be routed NW along a drainage leading to the Kings River a few miles east of Sutton. Alternative 3 ascends the drainage onto the plateau above Kings River and proceeds west towards Granite Creek, where the route would rejoin the baseline route and cross the creek.

Baseline Route – Alternative 4

Alternative 4 departs from the baseline alignment just prior to Moose Creek, bypasses the center of Palmer and traverses privately owned lands to the terminus at ENSTAR's 20-inch pipeline. Alternative 4 avoids construction within the more highly populated areas of Palmer.

3.3.2. Selected Route

One part of this project was to select an optimized route that would be used for the permit application. This study considered several factors in the process of choosing the final alignment for the lease application completion. These factors included (but are not limited to): proximity to high consequence and populated areas (e.g. schools, hospitals, towns), difficulty of construction, impacts to the environment, interference with traffic flow, proximity to potential problem areas (e.g. major rivers, slope stability problem areas), and ease of securing a right-of-way.

In all cases the alternative routes described above were selected as the optimum route. However, the selected version of the Alternative 1 route was a modification of the original Alternative 1 route. The following sections describe the selection process for each alternative.

Alternative 1 vs. Baseline Route

A modified version of Alternative 1 was selected for this portion of the route. The conceptual report shows the alternative route beginning a few miles further north of Glennallen and traversing cross-country in a southwesterly direction and intersecting with the highway just a few miles beyond the edge of town. However, the new alternative precedes cross-country in a direct westerly direction along a section line that bisects Ahtna, Incorporated (Ahtna) owned lands from a point approximately 2-miles north of town. Refer to the *ENSTAR Alignment/Lands Report* (ANGDA, 2005c) for more specific definition of the route along the section line. This modified alternative meets the Glenn Highway right-of-way much farther beyond Glennallen (approximately 12-miles) than the previous alternative.

The alternative was selected over the baseline alignment (along the Glenn Highway through Glennallen) for a number of reasons. Generally, when selecting a route it is preferable to avoid populated areas whenever possible. The route north of Glennallen misses the densest portion of Glennallen. In addition, the bypass route will mostly eliminate any construction impacts to traffic flow, driveway/minor road crossings, interference with utilities, etc.

Potential impacts to subsistence and the environment were also considered during selection of the alternative route north of town. No adverse affects to either are anticipated in this area.

Alternative 2 vs. Baseline Route

The pipeline alignment follows Alternative 2 from Eureka Roadhouse to Chickaloon. This route leaves the highway right-of-way just west of the Eureka Roadhouse and crosses State owned lands as it traverses mostly gradual slopes along portions of the Squaw, Caribou, and Boulder Creek drainages.

By virtue of being located in the bottom of a well-defined drainage complete avoidance of wetlands will likely be difficult, though wetlands will be avoided wherever technically and economically feasible.

Another concern with selection of the alternative route in this area is that construction of the pipeline will create new, and improve existing, access trails/roads to the valleys that the route transcends. Potential increase in vehicular traffic visiting the area both during construction and operation is a concern. However, it is the intent of ANGDA that construction and revegetation of the right-of-way will be performed in a manner that does not aid the ease of access. Some areas may require added features, such as block points, to ensure that this happens.

The baseline route for this segment follows the highway from Eureka Roadhouse to Chickaloon. A number of very challenging construction areas exist along this portion of the route. In particular the current sections of highway right-of-way near Caribou Creek, Pinochle Hill, and Hicks Creek present particularly challenging, if not impassable, terrain. Many sections of highway right-of-way in this area are “bottlenecked” by mountains and rivers making this route cost prohibitive and potentially dangerous to construct in. Construction along all portions of this part of the baseline route will also create substantial traffic delays.

Alternative 3 vs. Baseline Route

From Kings River to Granite Creek the route follows Alternative 3. This route is still pending field reconnaissance of the drainage that the pipe will follow up and out of the Kings River drainage. However, it is the preferred route because it bypasses a low-lying section of roadway that crosses terrain that presents challenges to construction of a pipeline in the area. Pending the aforementioned verification, the alternate route does not provide major pipeline construction hurdles. It also eliminates any impact to traffic flow along the highway in this area.

Alternative 4 vs. Baseline Route

From Moose Creek to the ENSTAR tie-in the Alternative 4 route has been selected. The alternate bypasses the middle of Palmer by skirting cross-country towards the Palmer Fishhook Road and southwest through the subdivisions midway between Palmer and Wasilla. Eventually the alignment joins the new Trunk Road right-of-way and follows it south to its intersection with the Parks Highway right-of-way.

Selection of the Alternative 4 route enables the pipeline to avoid the center of a populated town and decreases the impacts that would result during construction (e.g. impedance of traffic, driveway/minor road crossings, navigation of the busiest utility areas, etc).

Section 4. Pipeline Route Description

The final spur line route alignment is a combination of the baseline route and the alternatives that were discussed in Section 3.3. Figure 4.1 shows the entire route.

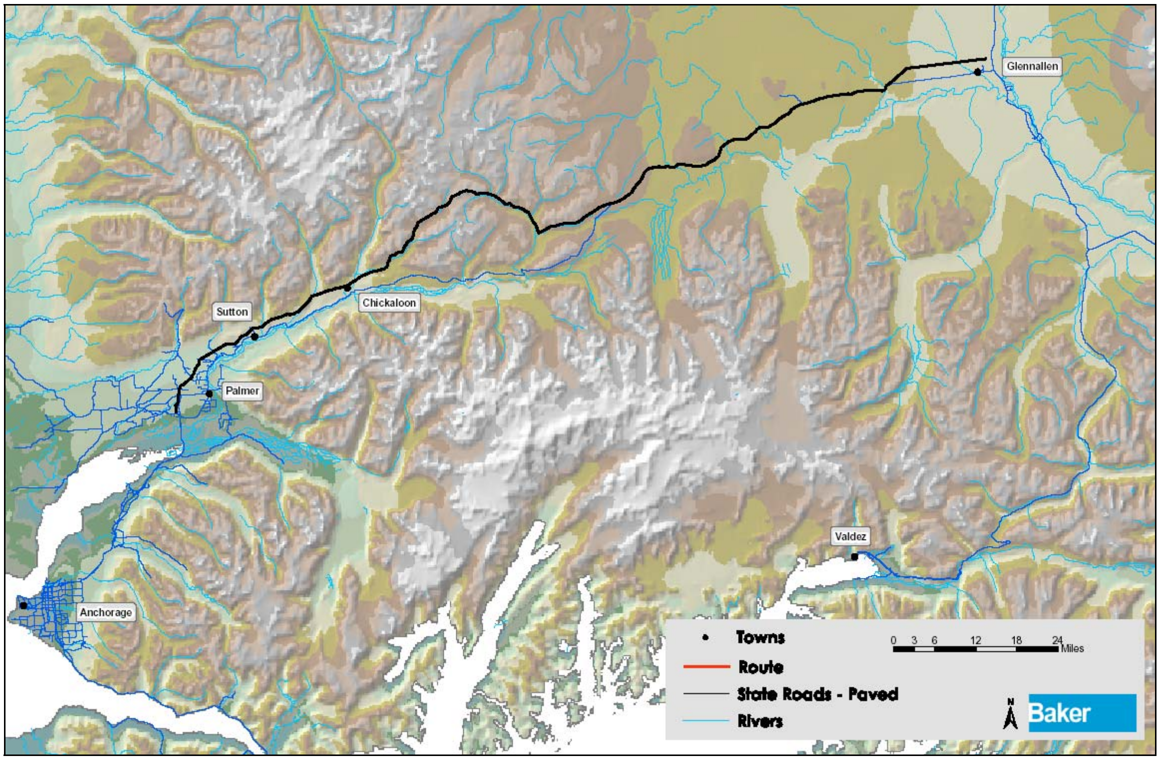

Figure 4.1: Pipeline Route

4.1. General Route

Milepost (MP) 0.0 to MP 15.2: Glennallen Bypass

The Glennallen to Palmer spur line route begins near the TAPS right-of-way, approximately 2-miles north of Glennallen and proceeds directly west for approximately 11.6-miles before turning southwest and joining the Glenn Highway right-of-way. The route intersects the Glenn Highway right-of-way roughly 13-miles west of Glennallen. This section of land is flat and marshy with black spruce forests.

This portion of the route will traverse property that belongs to Ahtna. This alignment was preferred because of its simplified route that bypasses most of the Glennallen area and avoids conflict with populated areas. It also allows for the installation of a natural gas liquids (NGL) plant and/or power generation plant on Ahtna owned lands.

MP 15.2 to MP 59.9: Glenn Hwy to Eureka Roadhouse

From the juncture with the Glenn Highway, west of Glennallen, the route will proceed to the west within the highway right-of-way across the remainder of the Copper River Basin. The alignment through this section will remain within the highway right-of-way, but encounters some significant obstacles and challenging soil conditions that will require future investigation to determine the final routing.

After leaving the Glennallen area the route soon encounters Tolsona Creek (MP 16.0). The final alignment through this area will require a detailed study at a future date when conditions allow for the investigation of the soils in the area. Due to a combination of inhabitance (campground, lodge, etc) and questionable soil conditions a future investigation may reveal that a route just to the north of this area will better accommodate the pipeline.

A few miles west of Tolsona Creek (near MP 20.6), the south side of the highway right-of-way becomes better suited for the construction of the pipeline. A road crossing is recommended here and the pipeline will follow the south side of the road west for approximately 8.5-miles (MP 29.2) before crossing back to the north side of the road.

Similar to the Tolsona Creek area, the alignment near the Little Nelchina River crossing (MP 50.9) may also require route modifications at a later date pending the outcome of a future investigation of the area. Glacio-lacustrine soils are evident in this area, thus introducing significant local slope stability issues. These issues are confirmed by visible evidence along the adjacent highway embankments entering the drainage area. A route that leaves the highway right-of-way just east of the drainage and in the northwest-west direction, traversing the natural topographic contour, to an upstream crossing location of the Little Nelchina River, and around the northeastern facing slope, before returning to the highway right-of-way, may be more ideal and should be considered once a more detailed investigation of the area is possible.

In general, the entire route between Glennallen and Eureka Lodge will be constructed through areas with challenging soil conditions. However, because the pipeline will likely be operated at ambient temperature, and because the construction will take place during the winter season, the resulting thermal affects can be minimized.

<u>MP 59.9 to MP 110.5: Eureka Roadhouse to Chickaloon River</u>

Just west of the Eureka Roadhouse a couple miles, where the highway begins to head southwest to skirt Gunsight Mountain, the pipeline will deviate from the road (MP 62.4) and travel cross-country to the west down the Squaw Creek drainage. At the confluence of Squaw Creek and Caribou Creek (MP 74.4) the route will angle to the north and ascend the Caribou Creek drainage up to Chitna Pass (MP 88.9). After Chitna Pass the route descends the Boulder Creek Valley and eventually crosses the Chickaloon River (MP 110.5) more than a mile upstream of the town of Chickaloon.

<u>MP 110.5 to MP 147.9: Chickaloon to Palmer</u>

Leaving the Chickaloon area in the westerly direction, the route will follow portions of the Chickaloon Trail and continue into the Kings River drainage. The route then follows the drainage downstream, eventually crossing Kings River, and exiting the drainage to the west about 2-miles before the river meets the Glenn Highway. This diversion (near MP 120.3) up onto the plateau that separates Granite Creek drainage from the Kings River drainage enables the route to bypass some difficult construction areas along the Glenn Highway where the road is following the Matanuska River. This route also steers clear of interference with a number of homes that are located along the road in this area, and will not create an impedance of traffic during construction.

The route crosses Granite Creek, about 1.2-miles above the highway, and proceeds to the south-southwest, avoiding the more populated portion of the Sutton area. After skirting the Palmer Correctional Center and crossing Moose Creek, upstream of the highway, the alignment begins to head away from the Glenn Highway and negotiate private lands, eventually crossing the Palmer Fishhook Road and intersecting with the new Trunk Road alignment. At the intersection of the new Trunk Road and the Parks Highway (MP 146.4), a directional bore, from the east side of Trunk Road, will allow the pipeline to cross the Parks Highway.

Once within the Parks Highway right-of-way, on the southwest side, the route will continue south and eventually pass the Parks Highway junction with the Glenn Highway. Another bore will be required for the pipeline to cross under the railroad just prior to the terminus of the pipeline. The proposed terminus for the pipeline will be at the tie-in with the existing ENSTAR 20-inch pipeline, located just south of the Nelson Road and Glenn Highway junction (MP 147.8).

4.1.1. Land Ownership

The pipeline alignment crosses both state and privately owned properties, in addition to federal properties that are in ownership transition. The proposed pipeline enters onto lands that have been State Selected and Tentatively Approved for conveyance. The current number of State owned parcels continues to change due to the ongoing processing of applications by the BLM and State.

The spur line route, wherever possible and reasonable, utilizes state owned lands. For this reason, a majority of the route is located on lands that are owned by the State of Alaska. Table 4.1 provides a land ownership line list for the route, which identifies lengths of the route that are located on particular land ownership entities and the number of parcels crossed for each. Note that the values in this table are based on preliminary land ownership research that was performed for the project. Because it is preliminary, there is the possibility that some of the values might be revised at a later date when a more complete study may be performed. For further detail regarding the land ownership and legal description along the route refer to the *ENSTAR Alignment/Lands Report* (ANGDA, 2005c) that is being developed concurrent to this report.

Table 4.1: Land Ownership Line List

Entity	Route Length Crossing [miles]	Number of Parcels
State of Alaska	38.8	152
Department of Transportation	47.0	7
Public Land Order Easement	N/A	107
Mental Health Trust	12.4	18
University of Alaska	2.3	6
Native Corporation	28.7	28
Borough	1.6	3
Private	17.0	140

State Lands

The spur line alignment crosses 183 land parcels that are patented or are in Tentative Approval status to the Sate of Alaska. Of these parcels, 79 are also subject to a Public Land Order Highway right-of-way. An additional 28 land parcels owned by others are also subject to a Public Land Order Highway Right of Way.

Federal Land Applications

The alignment crosses 100 parcels of land that are in ownership transition from Federal ownership to State, Native Corporation and Private ownerships. These lands are defined as State Selected, Tentatively Approved, Interim Conveyance, Native Allotment Application and Private.

Private, Native Corporation, and Municipal Entitlement Lands

The alignment for the pipeline crosses 171 properties owned by either Private, Native, or Borough.

4.1.2. Physical Environment

The Glennallen to Palmer spur line project encompasses two distinctly different terrains. The first portion of the route traverses the western edge of the Copper River Basin. This territory is generally flat, or gradually sloped, and is dominated by swamp and black spruce fauna. The second portion of the route traverses through both mountainous and rolling hill topography paralleling and crossing numerous glacially sculpted drainages before reaching the Mat-Su Valley.

The elevation along the route ranges from approximately 500-feet to over 4,000-feet. Vegetation species change with altitude, temperatures, and precipitation. See Table 5.2 for a complete list of vegetation along the route.

The entire route crosses an area that contains the potential of permafrost soils. Permafrost is defined as earthen material, which remains frozen (<32° F) during the entire year for two or more years. Ambient temperature and depth of snow are controlling factors in the regional distribution of permafrost. As a result, latitude, elevation, and snow accumulation often determine distribution patterns. In addition to identifying the distribution patterns of frozen ground, it is important to delineate those areas that are sensitive to thermal change.

MP 0.0 to MP 59.9 - TAPS Right-of-Way to Eureka Roadhouse:

> The route along this nearly 60-mile long portion of the plateau crosses numerous mild sloped drainages that drain into Tazlina Lake, which occupies the middle of the valley to the south. The major drainages crossed along this segment of the route include Moose Creek (near Glennallen), Tolsona Creek, and the Little Nelchina River.
>
> The soils in this portion of the route are comprised of the glacio-lacustrine landform of the Copper River Lowland. The genesis of this landform is a large glacio-lacustrine environment created by a glacially dammed lake in what is known as the Copper River Basin. The non-lithified, non-sorted or poorly sorted soils contain a wide range of particle sizes from clay/silt to cobbles and boulders (drop stones) that are sometimes referred to as diamicton. The glacio-lacustrine soils include varved clay, silty clay, clayey silt, very fine sand, and occasional layers of sand, gravel, cobbles, and boulders. The finer-grained materials may

have largely settled out of suspension in quiet waters while silt, sand, gravel and cobbles rained down from melting icebergs floating in nearby lakes.

The thermal conditions in the Copper River Basin are also complex. Permafrost is particularly sensitive to even minor surface disturbance because the ground temperature is so close to 32°F. Additionally, surface and groundwater movement generally preclude permafrost formation in some areas. The thermal state of the soil is highly variable. Soils are generally frozen, warm, discontinuous permafrost (70 to 95 percent frozen). Fine-grained soils and north facing slopes are predominantly frozen. However, areas with south facing slopes, lakes and stream crossings are typically unfrozen to sporadically (10 to 40 percent) frozen.

MP 59.9 to MP 147.9 - Eureka Roadhouse to Palmer:

From Eureka Roadhouse to Palmer, the spur line route crosses through a mountainous region and rolling hills. Heading west at approximately MP 62.4, the route first utilizes the Squaw Creek and Caribou Creek drainages, which are both tributaries of the Copper River Basin watershed. After crossing over Chitna Pass the route transcends the Boulder Creek drainage and enters the Matanuska River valley paralleling the river west to southwest towards the Knik Arm of Cook Inlet. The topography of the area contains steep side slopes and rolling hills. Major streams crossed by the route in this segment include Squaw Creek, Caribou Creek, Boulder Creek, Chickaloon River, Kings River, Granite Creek, and Moose Creek (near Sutton).

Soils consist of thick silts and organic (muskeg) deposits over glaciofluvial deposits, and alluvial deposits in river floodplains. Shallow bedrock is also expected in various areas along the route. The segment contains sporadic permafrost (10 to 40 percent frozen) and is composed mostly of thaw stable soils. Permafrost is mostly absent but isolated pockets may occur where protected by thick organics. Where permafrost occurs soils are most likely thaw unstable. Limited geotechnical data exists for this segment of the route.

4.1.3. Climate

The pipeline will traverse two distinct climatic zones. The origin of the pipeline corridor is within the Continental Climatic Zone and experiences extreme temperatures with moderate to high amounts of rainfall in the higher elevations. Depending upon the elevation, distinct weather changes can be anticipated along the pipeline right-of-way corridor. The Transitional Climatic zone, which encompasses the final 50-miles of the route, is influenced by Cook Inlet and typically experiences moderate winters and cool summers with significant cloudiness and rainfall.

4.1.4. Active Fault Crossings

The pipeline route crosses the mapped Caribou fault twice (see Figure 4.2). Once near the confluence of Chitna Creek and Caribou Creek, and once in the Boulder Creek drainage approximately 6-miles northeast of the confluence of Black Slate Creek and Boulder Creek.

The route also crosses the mapped Castle Mountain fault in the Boulder Creek Flats approximately one mile northeast of the confluence of Black Slate Creek and Boulder Creek. The map trend of the Caribou and Castle Mountain faults projects to the east-northeast, which is toward the eastern portion of the pipeline route.

Faults with suspected Holocene activity (movement within the past 11,000 years; Yeats and others, 1997) that cross, or tend directly toward the route corridor, will require extensive field investigation and characterization to determine location, return period, and sense and magnitude of movement for proper design of the pipeline.

There is very little known about the east end of these two faults and their possible extension across the Glenn Highway corridor. Extensive evaluation and field investigation should be considered before final route selection.

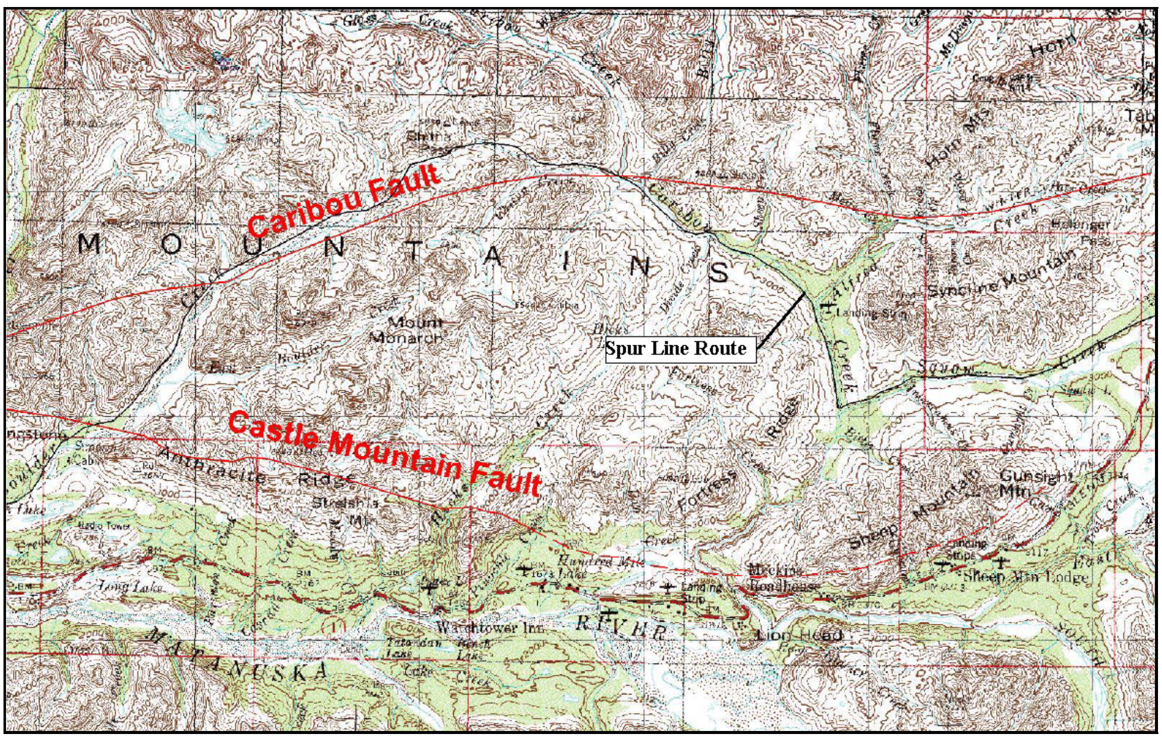

Figure 4.2: Castle and Caribou Fault Locations

4.2. Origin – Glennallen

Depending upon the final desired configuration either a gas compression or gas compression/processing facility will be located near the origin of the spur line. In the former case, the facility will only boost the pressure of the gas from the inlet pressure to the final desired pipeline pressure. In the latter case, the facility will boost the pressure of the gas and adjust the hydrocarbon composition of the incoming gas to comply with the composition specified for the pipeline.

The site requirements for the gas compression only facility will be substantially smaller than those for the combined compression/processing facility. While the actual size of main facility components will vary greatly between the two cases, there are several similarities between the two scenarios. Each will require compression capabilities, relief systems, and possibly power generation and chilling capacity. A pig launcher will also be required at either site.

The combined gas compression/processing facility will further require a natural gas liquid processing facility to adjust the hydrocarbon composition of the gas prior to injection into the pipeline. The requirements of this processing facility will depend upon both the composition of the inlet gas, as well as the final desired composition of the pipeline gas.

4.2.1. Typical Compressor Station

The pressure of the gas flowing through the pipeline will decrease in the direction of flow along the pipe. The purpose of a compressor station is to return the pressure of the gas to the maximum operating pressure of the pipeline.

Depending on the mode of pipeline operation, a refrigeration system may be required to cool the compressor discharge gas to a temperature below 32°F prior to the gas reentering the pipeline. Thermal-hydraulic simulation of the pipeline is required to determine the seasonal refrigerant loads since operation of both the gas compression and refrigerant system will vary seasonally. The refrigerant load will be the greatest during the warmer periods of the year with minimal to no refrigerant loads encountered during the winter.

A process flow diagram for a typical gas compression system with propane refrigeration of the discharge gas is shown in Figure 4.3.

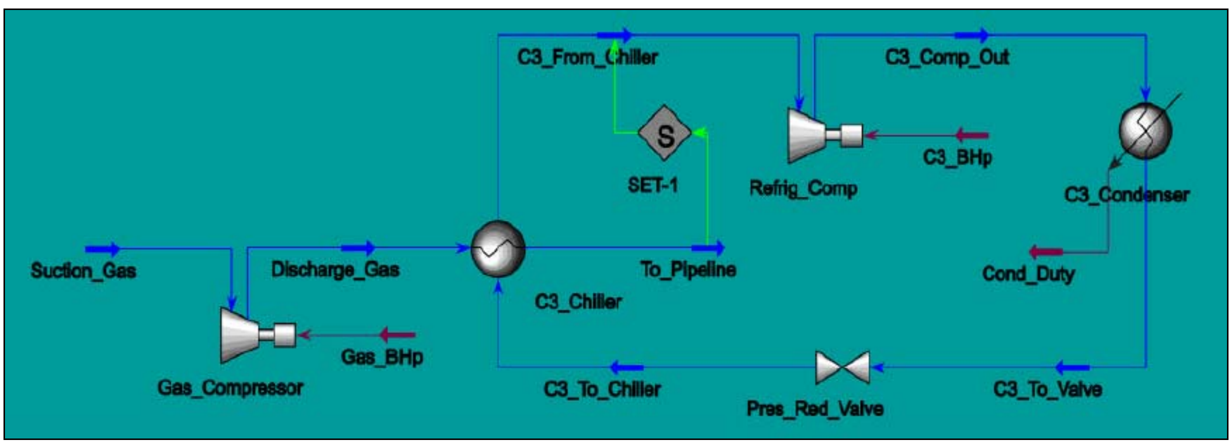

Figure 4.3: Typical Process Flow Diagram, Compressor Station with Refrigeration

4.2.2. Typical NGL Plant

Without clear definition of the processing requirements at the inlet facilities it is difficult to summarize an appropriate layout. However, assuming a facility will be used to remove the hydrocarbons and produce a sales quality gas for the spur line, the general layout of the components involved in the process is illustrated in Figure 4.4.

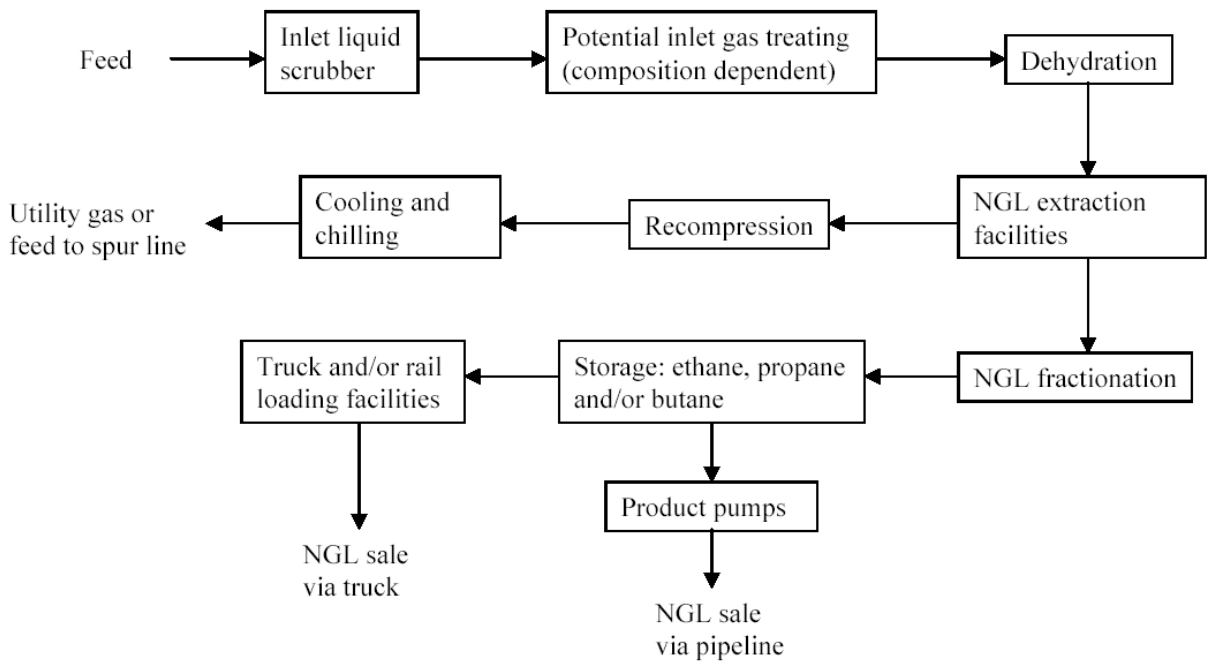

Figure 4.4: Conceptual NGL Facility Layout

Inlet liquid scrubber

Inlet scrubbers are typically used to remove any liquids entering the facility with the feed gas. An inlet scrubber may not be required for an NGL facility located at the inlet of the spur line if the feed gas is obtained from a high-pressure dense phase pipeline. An inlet scrubber may be required for a facility at the end terminus of a spur line depending upon the operating pressure of the spur line at this point.

Liquids from the scrubber are typically processed through a stabilizer with the volatile components routed to the plant gas feed. The residual liquids are typically routed to NGL fractionation or stored temporary and removed via truck depending on their composition.

Potential inlet gas treating

Inlet gas treating may be required to remove hydrogen sulfide and carbon dioxide depending on the composition of the feed gas. Typically, utility gas contracts require removal of essentially all hydrogen sulfide and removal of carbon dioxide down to a prescribed level. Carbon dioxide may have to be removed in order to prevent formation of solid carbon dioxide (dry ice) within the cryogenic portions of the facility. Amine type facilities are typically used for removal of hydrogen sulfide and carbon dioxide although other processes are available.

Dehydration

Dehydration facilities are used to remove water from the feed gas prior to the cryogenic portion of the process in order to prevent formation water ice. Dehydration will definitely be required if an inlet gas treating facility is installed that uses an aqueous solvent such as amine. Dehydration is typically accomplished using molecular sieve beds that are periodically regenerated by heating.

NGL extraction

NGL extraction is typically accomplished based on the advantageous use of heat exchangers and Joule-Thompson cooling of a methane-rich gas achieved by dropping the pressure of the feed. A key component of the NGL facility is the de-methanizer column in which the condensed NGL is removed leaving a residue gas. The configuration of the de-methanizer will vary depending the degree of NGL extraction and composition of the NGL required. Typically, the de-methanizer is configured to both produce a NGL product that contains very little to no methane and a utility grade natural gas.

Recompression

Recompression of the residue gas leaving the NGL extraction facility is required to raise the pressure of the gas either to the inlet pressure of the spur line or to the operating pressure of ENSTAR's pipeline system depending on whether the facility is located at the beginning or end terminus of the spur line. Recompression facilities to accommodate the 1 billion standard cubic foot rate that being considered for the spur line will require a significant amount of installed compression horsepower. Recompression for large facilities is typically accomplished using natural gas fired turbines to drive multiple stages of compression.

Cooling and chilling

The temperature of the residue gas will increase as the gas is recompressed to facility discharge pressure. Fan type air coolers may be used to cool the gas between stages of compression. Air coolers will likely be required to cool the gas leave the last stage of recompression. A mechanical refrigeration system may be required for a NGL facility at the inlet of the spur line if the spur line is design to operate in a cold mode at temperatures below 32 degrees Fahrenheit.

NGL fractionation

NGL fractionation is used to separate the mixture of hydrocarbons leaving the de-methanizer into its various components. NGL fractionation consists of a series of distillation columns that sequentially remove the most volatile component contained in the NGL mixture. A de-ethanizer column is used to first remove an ethane product. Similarly, a de-propanizer is used to separate propane from butane and heavier components. Sometimes a de-butanizer is installed to separate butane from what is essentially a light gasoline product. Although unlikely for an Alaskan facility, sometimes a butane splitter column is used to separate iso-butane from normal-butane.

Product storage

Neither the NGL facility located at the beginning of the spur line near Glennallen nor at the intersection of the Glenn and Parks highways near Palmer will be near tidewater and thus require bulk storage of NGL products to accommodate periodic loading of tanker vessels via a marine terminal. It is assumed that NGL storage at the facilities will consist of surge capacity as required to accommodate the disposition of products via truck, rail or liquid pipeline(s). Storage for the purposes of surge capacity can be accomplished via the installation of numerous large cylindrical pressurized tanks. The pressure of the storage vessels will vary according to the commodity being stored.

Truck and/or rail loading facilities, product pumps

Distribution of NGL products such as propane to local markets is typically accomplished via a truck loading rack utilizing flexible hose connections. The Alaska Railroad Corporation (ARRC) system is within close proximity to the terminus of the spur line near Palmer and the option exists to load products into rail cars using an articulated loading arm system. Product disposition via pipeline is done using dedicated pumps.

4.2.3. Power Generation Facility

Capacity requirements for a power generation facility capable of operating the required compression and processing facilities at the spur line origin are difficult to establish without additional details regarding the composition of the inlet gas and the desired composition of the product. However, allowances for a plant that is similar to a current facility at North Pole have been requested by ANGDA. This particular facility is a 50-60 megawatt plant that can co-generate up to 90 megawatts. The facility resides on plot that is approximately 15-acres in size.

4.2.4. Possible Layout of Inlet Facilities

Until further development of the project and the project contingents has occurred it is difficult to specify the detail necessary to accurately define a compression/processing/power generation facility, as is desired by ANGDA. However, a simplified schematic of the site has been drafted and is shown in Figure 4.5. Pending commencement of design it is assumed that the facilities will occupy the entire plot area (approximately 55-acres). The property adjacent to the indicated site limits is available and could potentially be used should final design determine that more area is required to accommodate the facilities. Details of the facilities contained herein are discussed in Sections 4.2.1, 4.2.2, and 4.2.3 above.

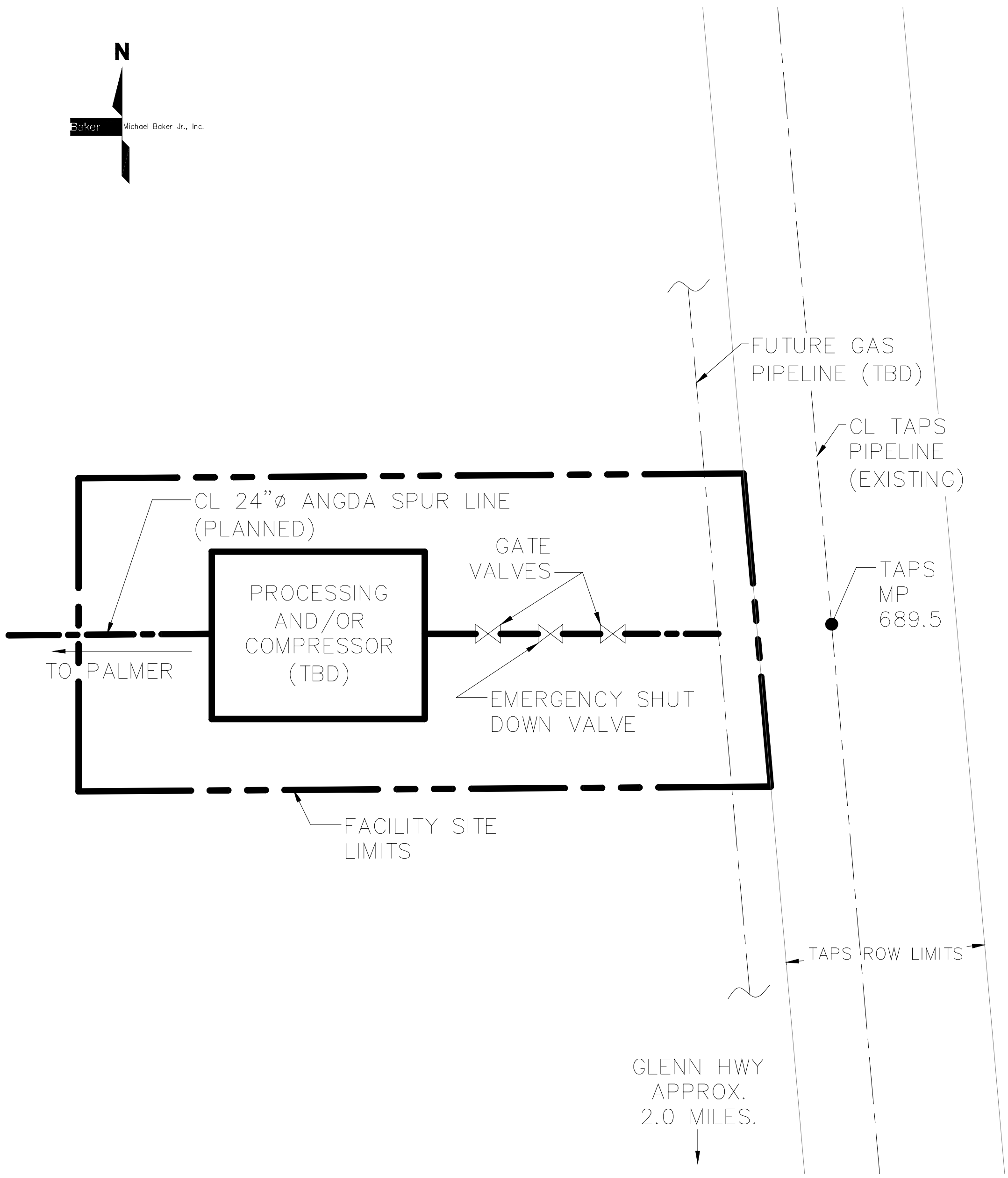

Figure 4.5: Conceptual Origination Connection

4.2.5. Site Soil Conditions

General soil conditions in the area of the pipeline origin typically consist of a vegetative (organic) mat ranging in thickness from six to twelve inches at the surface. The vegetative mat is primarily underlain by silty soils, although soils consisting of any combination of silts, sands and gravels are not uncommon. Individual ice crystals and inclusions are typical as is the presence of shallow groundwater. Soil temperatures of the permafrost can be relatively warm with temperatures that range between 31.0°F and 31.9°F not uncommon. The permafrost conditions, thermal state and active layer of the soil is dependent on a variety of conditions including but not limited to vegetation, slope aspect, snow coverage and seasonal temperatures.

Geotechnical considerations must be taken into account when designing and constructing any structure including a gravel facility in this region. In general the thaw thermal state of the subsurface soil must be maintained to minimize the potential of differential thaw settlement and frost jacking. Typical design and construction practices in the area include erection of buildings on driven piles. Slab on grade facilities are not uncommon with the aid of refrigerated foundation systems. A thorough geotechnical investigation including foundation design recommendations is warranted at the gas compressor facility.

4.2.6. Land Ownership

The starting point of the ANGDA pipeline is near milepost 689.5 of the Trans Alaska Pipeline (TAPS). The ANGDA pipeline and related gas treatment and compressor facilities will be located on approximately 15-acres of Ahtna land, within Section 13, Township 4 North, Range 2 West, Copper River Meridian. An AHTNA and ANGDA agreement will provide land for the proposed facilities. The ANGDA pipeline continues westerly across Ahtna lands for approximately 15.3-miles to the location where the pipeline enters the Glenn Highway right-of-way near milepost 173. For further detail regarding the land ownership and legal description refer to the land alignment report (ANGDA, 2005c) that is being developed simultaneous to the generation of this report.

4.3. Terminus – Palmer

The spur line will terminate south of the Glenn and Parks Highway interchange, at MP 147.9, near the location of the existing ENSTAR 20-inch pipeline, which follows the a portion of the Glenn Highway along its route between Beluga and Anchorage.

4.3.1. Possible Layout of Outlet Facilities

Per direction from ANGDA, preliminary selection of a site has been made near the spur line tie-in with the existing ENSTAR pipeline. This site is intended to accommodate the “required facilities”, defined by ANGDA as inclusive of a gas compression facility, an NGL processing facility capable of adjusting the hydrocarbon composition of the gas prior to injection with the ENSTAR pipeline, and a power generation facility.

The eventual destination of the sales quality gas is the ENSTAR 20-inch pipeline which borders the proposed facility site along the north and east sides of the property (see Figure 4.6). This figure shows a schematic layout of the connection to the ENSTAR pipeline. Pending commencement of design it is assumed that the facilities will occupy the entire site limits as shown on the drawings (approximately 53-acres). The adjacent lots, along the ENSTAR line in either direction, are also available and could potentially be used should final design determine that more property is required to accommodate the facilities. Details of the facility components were discussed previously in Sections 4.2.1, 4.2.2 and 4.2.3 above.

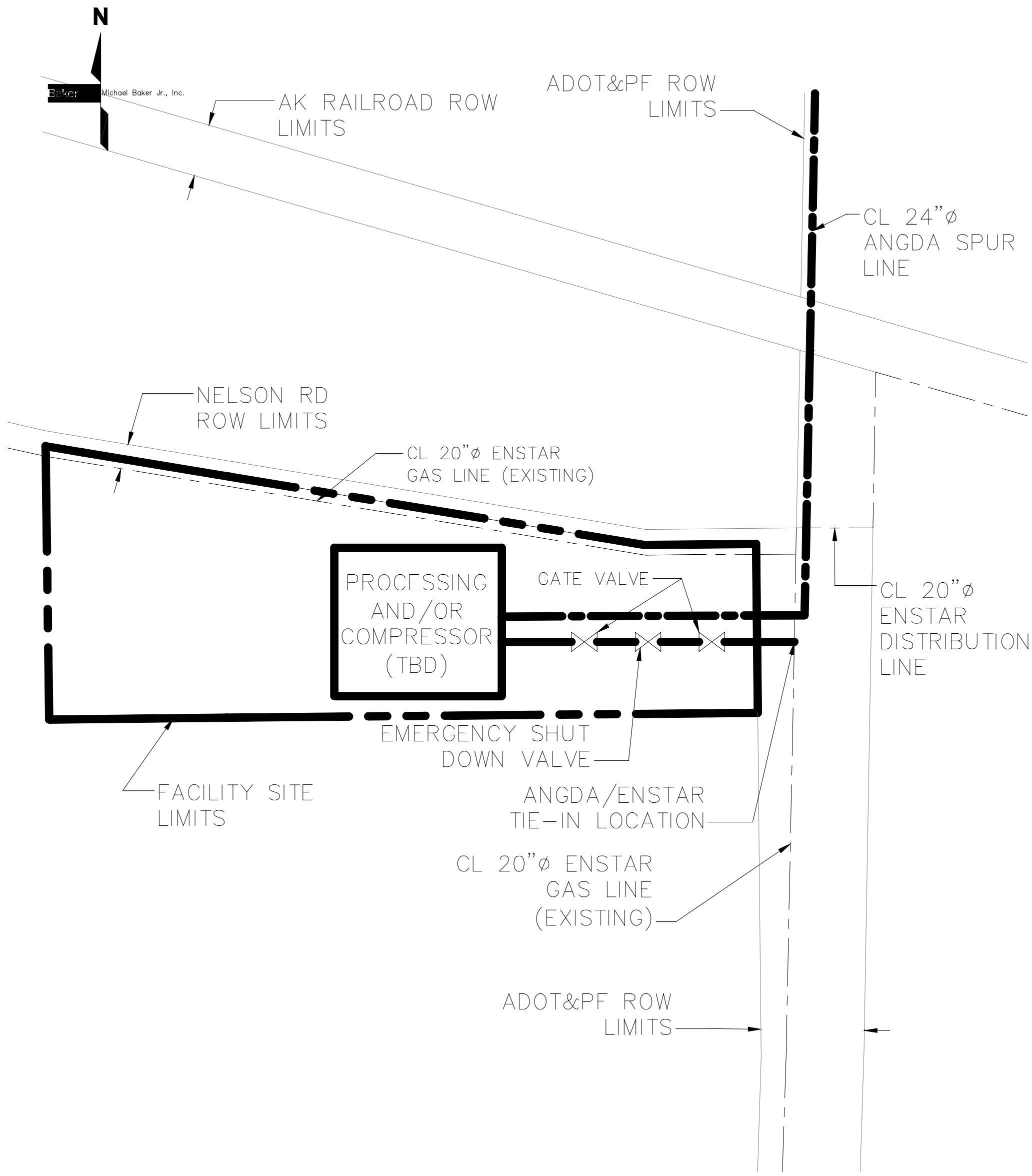

Figure 4.6: Schematic Terminus Facility Layout

ANGDA has indicated that at this time no allowances should be made for the site removal of the residual gases (e.g., propane, butane) that remain after the gas has been separated and is sent into the ENSTAR system. This issue will need to be addressed at a later date.

4.3.2. Site Soil Conditions

General soil conditions in the area of the pipeline terminus consist of a vegetative (organic) mat ranging in thickness from six to twelve inches at the surface. The vegetative mat is primarily underlain by sands and gravels although soils consisting of any combination of silts, sands and gravels are not uncommon. Groundwater is typically greater than ten feet, however a shallow groundwater table is not uncommon. Permafrost is not common in the area near the terminus.

Geotechnical considerations must be taken into account when designing and constructing any structure including a gravel facility in this region. In general foundation design in the region involves stripping the area of organics and frost susceptible soils and replacing the area with the adequate thickness of non-frost susceptible (NFS) soils. Placement of NFS and proper drainage design minimizes the potential of differential thaw settlement and frost jacking. A thorough geotechnical investigation including foundation design recommendations is warranted at the gas processing facility.

4.3.3. Land Ownership

Additional pipeline facilities will be situated at the ANGDA termination point on an 80-acre land parcel, presently owned by the Matanuska-Susitna Borough. The lands are located near the intersection of the Parks and Glenn Highways. The land parcel is known as the S1/2 of Section 22, Township 17 North, Range 1 East, Seward Meridian and lies adjacent to the ENSTAR Beluga 20-inch pipeline. A Matanuska-Susitna Borough and ANGDA agreement will provide land for the proposed facilities. For further detail regarding the land ownership and legal description refer to the land alignment report (ANGDA, 2005c) that is being developed simultaneous to the generation of this report.

Section 5. Environmental

An environmental document to evaluate the effects of construction and operational activities on the communities, wildlife, and habitat, prior to the issuance of a permanent right-of-way lease for the ANGDA spur line will need to be developed.

5.1. River and Stream Crossings

Title 16 of Alaska Statutes (AS) regulates all activities that may affect anadromous fish streams or that may result in blockage of fish passage. Anadromous fish streams are defined as those where fish hatch and rear, migrate as smolt from freshwater to the ocean, and return as spawn from the ocean. Anadromous rivers and streams along the right-of-way corridor may be crossed with open cut trenches or HDD techniques. Open cut, fluming, or dam-and-pump techniques will be used to cross other drainages. The determination of which crossings will be installed by HDD will be decided through consultation with the Alaska Department of Natural Resources (ADNR)/Office of Habitat Management and Permitting (OHMP). The decisions will depend on site conditions. All activities will be in accordance with applicable federal and state regulations. Excavated soils may be replaced in the streams to restore the original streambed conditions. Equipment crossings will be in compliance with ADNR/OHMP regulations.

Water intakes will be designed to protect aquatic life. Energy dissipation techniques will be used on all discharge points to prevent erosion and sedimentation. Dam construction will be tailored to the size, geology, and local environmental constraints at each location. During dam-and-pump (isolated) crossing, water quality will be monitored. Turbidity and total suspended solids can be used to monitor water quality to impacts on fish habitat. Allowable water quality parameters will be set depending on the type of fish present, time of year, and characteristics of the stream.

Removal of water from fish bearing rivers, streams, and natural lakes will be subject to prior written approval by Division of Mining, Land and Water (DMLW), Alaska Department of Fish and Game (ADF&G), and OHMP. Use of explosives is prohibited in open water areas of fish bearing streams and lakes. Stream work will comply with ADNR stipulations. Pipeline burial along slopes must be designed to minimize erosion potential. Disturbed areas should be seeded with native species at the earliest opportunity to minimize erosion and siltation. Rivers and streams crossed by the proposed spur line alignment are presented in Table 5.1.

Table 5.1: River and Stream Crossings

MP	Name	Fish	Anadromous	MP	Name	Fish	Anadromous
0.6	Unnamed Tributary to Moose Creek	Unk	No	64.8	Startup Creek	Yes	No
0.9	EF Moose Creek	Yes	No	65.2	Unnamed	Unk	No
1.7	Unnamed	Unk	No	65.6	Unnamed Tributary to Squaw Creek	Unk	No
3.8	Moose Creek	Yes	No	66.3	Unnamed Tributary to Squaw Creek	Unk	No
16.0	Tolsona Creek	Yes	Yes	67.6	Unnamed Tributary to Squaw Creek	Unk	No
20.1	Little Woods Creek	Yes	No	68.7	Unnamed Tributary to Squaw Creek	Unk	No
23.9	Atlasta Creek	Yes	No	69.7	Unnamed Tributary to Squaw Creek	Unk	No
26.8	Tex Smith Lake Drainage	Yes	No	70.0	Unnamed Tributary to Squaw Creek	Unk	No
27.6	Unnamed	Unk	No	70.6	Unnamed Tributary to Squaw Creek	Unk	No
28.1	Unnamed	Unk	No	71.1	Unnamed Tributary to Squaw Creek	Unk	No
28.6	Unnamed	Unk	No	71.2	Unnamed Tributary to Squaw Creek	Unk	No
34.5	Woods Creek	Yes	Yes	72.8	Unnamed Tributary to Squaw Creek	Unk	No
35.8	Mendeltna Creek	Yes	Yes	72.9	Unnamed Tributary to Squaw Creek	Unk	No
41.2	Cache Creek	Yes	No	75.5	Unnamed Tributary to Caribou Creek	Unk	No
41.6	Unnamed	Unk	No	75.7	Caribou Creek	Unk	No
45.2	Unnamed Creek	Unk	No	75.8	Unnamed Tributary to Caribou Creek	Unk	No
45.7	Unnamed Creek	Unk	No	76.4	Unnamed Tributary to Caribou Creek	Unk	No
46.6	Unnamed Creek	Unk	No	79.3	Unnamed Tributary to Caribou Creek	Unk	No
48.6	Unnamed Tributary to Little Nelchina River	Unk	No	79.4	Unnamed Tributary to Caribou Creek	Unk	No
49.2	Unnamed Tributary to Little Nelchina River	Unk	No	80.1	Unnamed Tributary to Caribou Creek	Unk	No
49.7	Unnamed Tributary to Little Nelchina River	Unk	No	80.4	Unnamed Tributary to Caribou Creek	Unk	No
49.8	Unnamed Tributary to Little Nelchina River	Unk	No	81.0	Divide Creek	Unk	No
50.9	Little Nelchina River	Unk	No	83.7	Unnamed Tributary to Caribou Creek	Unk	No
53.0	Unnamed Tributary to Little Nelchina River	Unk	No	84.0	Unnamed Tributary to Caribou Creek	Unk	No
53.5	Unnamed	Unk	No	85.1	Chitna Creek	Unk	No
61.6	Old Man Creek	Unk	No	87.6	Unnamed Tributary to Chitna Creek	Unk	No

Table 5.1: River and Stream Crossings (cont.)

MP	Name	Fish	Anadromous	MP	Name	Fish	Anadromous
90.2	Unnamed Tributary to Boulder Creek	Unk	No	121.7	Young Creek	Unk	No
90.7	Unnamed Tributary to Boulder Creek	Unk	No	124.3	Little Granite Creek	Unk	No
92.3	Boulder Creek	Unk	No	126.0	Granite Creek	Yes	Yes
93.2	Unnamed Tributary to Boulder Creek	Unk	No	128.0	Eska Creek	Yes	Yes
93.4	Boulder Creek	Unk	No	134.3	Moose Creek	Yes	Yes
99.9	Boulder Creek	Unk	No	138.5	Carnegie Creek	Yes	Yes
100.1	Unnamed Tributary to Boulder Creek	Unk	No	140.3	Carnegie Creek	Yes	Yes
101.0	Unnamed Tributary to Boulder Creek	Unk	No	141.7	Wasilla Creek	Yes	Yes
102.9	Unnamed Tributary to Boulder Creek	Unk	No	143.1	Wasilla Creek	Yes	Yes
103.4	Blackshale Creek	Unk	No	143.3	Wasilla Creek	Yes	Yes
104.6	Boulder Creek	Unk	No	144.4	Wasilla Creek	Yes	Yes
110.5	Chickaloon River	Yes	Yes	147.2	Spring Creek	Yes	Yes
112.3	California Creek	Unk	No	147.4	Spring Creek	Yes	Yes
114.3	Unnamed	Unk	No	147.4	Spring Creek	Yes	Yes
117.9	Kings River	Yes	Yes				

5.2. Vegetation

Trees and shrubs within the pipeline right-of-way corridor have the potential to live 75- to 200-years, though few areas escape the wildfires that occur about once every 100-years (State of Alaska, 1999). Selkregg (1974) indicates severe climate, repeated fires, discontinuous permafrost and braided drainage systems created complex vegetation patterns. The area supports upland spruce hardwood forests, moist tundra, low bush bog and muskeg, and high bush. The lowland spruce-hardwood forests are dominated by black spruce with some balsam poplar, quaking aspen and paper birch. The understory is comprised of dense brush consisting of: green alder, thinleaf alder, willows, prickly rose, Labrador tea, bunchberry, grasses, forbs and mosses that are common on the forest floor. To see a complete summary of vegetation species that may be present in the right-of-way refer to the *Glennallen to Palmer Spur Line – Environmental Report* (ANGDA 2005a).

5.3. Wetlands

Project specific wetlands within the approximate 147.9-mile long right-of-way corridor were delineated using the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI). There is no NWI data available for two sections of the route comprising approximately 10-miles of the pipeline route. Of the remaining 138-miles, approximately 13-miles have been identified as wetlands. The remaining 125-miles is classified in the NWI as uplands. More detailed wetland delineation will be created as the project progresses. Wetlands classification used by the USFWS follows Corwardin et al. (1979) and defines wetlands according to ecological characteristics. The wetland locations are summarized in Table 5.2. For additional information on wetlands definition refer to the *Glennallen to Palmer Spur Line - Environmental Report* (ANGDA 2005a).

Table 5.2: Wetlands Location Data

Beg MP	End MP	Concern Wetland?	Beg MP	End MP	Concern Wetland?	Beg MP	End MP	Concern Wetland?
0.19	0.22	N	10.86	10.89	N	99.94	100.03	Y
0.84	0.89	N	10.89	11.12	N	100.52	100.71	N
1.02	1.11	N	11.22	13.22	N	100.83	101.13	N
1.11	1.14	N	13.22	13.25	N	102.01	102.37	N
1.14	1.32	N	13.25	13.45	N	103.22	103.24	N
1.32	1.35	N	13.55	13.61	N	103.91	104.22	N
1.35	1.54	N	13.61	13.70	N	104.22	104.25	N
1.54	1.62	N	14.43	14.49	N	104.33	104.43	N
1.64	1.69	Y	14.56	14.58	Y	104.43	104.57	N
1.82	1.87	N	14.58	14.64	N	106.84	106.87	N
1.99	2.21	N	14.67	14.73	N	107.36	107.40	N
2.26	2.53	N	15.10	15.27	N	110.55	110.58	Y
2.57	2.66	N	15.27	15.31	Y	110.58	110.63	N
2.80	2.85	N	15.31	15.33	N	110.63	110.67	Y
2.85	2.88	N	21.84	21.88	N	111.83	111.92	N
2.88	3.14	N	23.41	23.46	N	113.89	114.01	N
3.21	3.57	N	27.48	27.63	N	114.35	114.43	N
4.06	4.09	N	41.21	41.34	N	114.45	114.55	N
4.23	4.26	N	41.40	41.91	N	116.07	117.65	N
4.42	4.83	N	43.96	52.70	N	117.86	118.00	Y
4.83	4.84	N	56.88	56.90	N	125.95	126.13	Y
4.93	5.12	N	61.62	61.64	N	128.14	128.18	N
5.12	5.14	N	64.84	64.90	N	138.25	138.28	N
5.76	5.94	N	65.11	65.15	N	139.74	139.76	N
6.22	6.27	N	65.15	65.16	Y	139.79	139.82	N
6.42	6.56	N	65.16	65.31	N	139.82	139.90	N
6.91	6.92	N	66.01	66.06	Y	140.12	140.28	N
6.99	7.01	N	75.73	75.78	N	142.59	142.74	N
7.32	7.43	N	75.78	75.85	Y	147.37	147.39	N
7.95	8.00	N	78.45	78.47	N	147.39	147.41	N
8.51	9.83	N	78.57	78.60	N	147.79	147.81	N
9.83	10.61	N	92.05	92.31	N			
10.73	10.77	N	92.31	92.39	Y			

Wetlands adjacent to the pipeline ditch and those wetlands within the excavation footprint will be affected during pipeline construction. Portable construction mats in areas adjacent to the ditch will protect them from construction equipment. Wetlands that are excavated for pipeline installation will be impacted by the removal and replacement of the vegetative material. Where practical, the trench spoils will be replaced to accommodate re-growth.

The construction right-of-way corridor will be staked during late winter/spring and clearing and grubbing will commence in late winter/spring to avoid ground nesting bird disturbances. The upland and wetland areas will be temporarily disturbed by construction traffic and construction activities. Best Management Practices will be used to minimize the impacts. Future summer studies should include in-depth assessments of the wetlands.

A Hazardous Material Control Plan will be prepared and implemented throughout construction. Waste and hazardous materials will not be stored on the pipeline right-of-way. The plan will detail Best Management Practices to avoid polluting waters and wetlands.

5.4. Erosion Control

5.4.1. Trenching

Erosion control along the right-of-way corridor is an important criterion used to determine the pipeline design and construction techniques. The surface water and groundwater flow patterns will remain the same as before construction. Trenching activities will begin after the area is cleared and graded, and access to the work area has been secured. Drainage will be controlled in accordance with the approved, project-specific Storm Water Pollution Prevention Plan (SWPPP). Sedimentation fences, straw bales, or other drainage control devices will divert surface water from the trenching site. Excavation spoils will be placed where they will not affect drainage. Trench excavation spoils will be used as backfill if they meet project specifications. Backfill will be compacted to ensure pipe support and to reduce the amount of settlement. The backfill at the surface will be crowned approximately 6-inches to promote surface drainage away from the ditchline. Some areas may be covered with geofabric or other materials to prevent erosion. Disturbed areas should be seeded with native species at the earliest opportunity to minimize erosion and siltation.

Any water removed from the trench will be discharged in accordance with applicable permits to prevent erosion and siltation. Sedimentation can be controlled during excavation dewatering with use of sedimentation basins, straw bales, geofabrics, and silt fences. Ditch plugs will be installed periodically to prevent excessive groundwater flow through the ditch.

The project will require an Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) General Permit for Construction Activities, and Best Management Plans (BMPs) will be developed. The project will require permits and authorization that include an SWPPP, a Hydrostatic Water Discharge Plan, and a Temporary Waste Storage Plan.

5.4.2. Bank Stabilization

State of the art construction techniques will be used to stabilize rivers and stream banks. Some areas may be covered with geofabric or other materials to prevent erosion. Bank stabilization will comply with federal and state regulations to prevent erosion and sedimentation.

5.5. Right-of-Way Restoration

5.5.1. Revegetation

The pipeline right-of-way corridor will be graded, cleaned, seeded and fertilized following pipeline construction. Streams and wetlands will be restored, as practical, to their original condition. Revegetation will provide long-term erosion control. Native species will be planted to stabilize banks and minimize erosion. Impacts to streams that may result from open cut trenching and HDD will be minimal. Damage to vegetation will be minimized and all activities will be in accordance with an accepted SWPPP.

5.6. Water Sources

5.6.1. Hydrology

Rivers and streams crossing the study area are shown in Table 5.1. Currently, the right-of-way corridor will cross 81 rivers and streams and a few unmarked drainages. As the pipeline design progresses and more definitive ground data becomes available, other stream crossings may be added or removed. BMPs will be required for this project. The BMPs will eliminate or reduce impacts to air and water quality. The BMPs will be developed and designed specifically for the project locations to minimize erosion, siltation and/or spills.

Fresh water for hydrostatic testing and for mixing HDD drilling fluids will be taken from nearby water sources along the right of way corridor. Appropriate and approved water sources near the right-of-way corridor will be used for project requirements. Project specific water requirements will be established as the pipeline design matures. Water use will be approved and in full compliance with federal and state regulations.

5.6.2. Impacts to Waterbodies

No lasting impacts are anticipated for waterbodies that includes the anadromous rivers and creeks within or influenced by the buried pipeline right-of-way. Construction activities within, and in the proximity of, waterbodies will be conducted in full compliance with federal and state regulations to minimize the potential effects to local drainage patterns, stream diversion or impacts to habitats.

5.6.3. Water Quality

The natural drainage patterns along the right-of-way will not be altered by the installation of the pipeline. The water bodies in the project area include rivers, creeks, and small-unnamed drainages. Summer studies will determine water bodies that may be affected by pipeline construction or operations. Permits and authorizations will carry stipulations to ensure that the project is in compliance with all environmental safeguards.

Project water-related activities, including trench dewatering, drilling mud mixing, and hydrostatic testing, will be in compliance with federal and state regulations. The groundwater regime will not be significantly affected as a result of excavation dewatering. No impacts on existing water wells are anticipated.

The pipeline design and construction techniques will be in strict compliance with Title 49, Code of Federal Regulations, Part 192 (49 CFR 192). Additional safeguards to protect water quality include pipe manufactured with quality, high-strength steel and pipe wall thickness sufficient to resist internal and external loads; external protective coatings; non destructive examination

(NDE) of pipeline welds (e.g. radiography, ultrasonic); heavier wall pipe used at stream and wetlands crossings; and hydrostatic testing before operations pipeline integrity.

Hydrotest water will be discharged in accordance with applicable permits to avoid sedimentation and erosion. Field observations, monitoring, sampling, and reporting of discharges may be required the same day the discharge begins. Discharges will be examined daily for oil sheens or other agents. If a foreign substance is observed, samples of the discharge will be collected and analyzed. Discharges will be monitored to limit damage, erosion, sedimentation, and/or floating debris. Monitoring and testing will comply with stipulations in applicable permits. Discharge locations will be determined after fieldwork is completed. Discharges to dry stream channels, upland areas, or to a constructed settling pond or ponds is planned.

5.7. Spill Prevention

Potential impacts from spills will generally be confined to small areas on work pads and, should they occur, will be completely cleaned up. After construction the likelihood of spills and leaks will be low because operational activities along the pipeline will be minimal.

Spills resulting from the pipeline are not expected due to the nature of the product. Should pipeline failure occur the gases contained within will evaporate and be absorbed by the atmosphere. Some ice may form in the vicinity, as the line will be operating at or near ambient temperature.

Adequate quantities of absorbent material to handle spills will be available in the event of a spill. Spills will be reported in accordance with project requirements and will be cleaned up. Impermeable lined berms and basins will retain 110-percent of storage capacity plus 12-inches of freeboard. Vehicles will not be fueled in floodplains.

5.7.1. Hydrotesting

If it is determined that pipeline segments will be installed using HDD, those segments will be hydrotested prior to installation. The entire pipeline will be hydrotested in accordance with 49 CFR 192 before commissioning. Water for hydrotesting will be withdrawn from the river or stream being crossed or imported from another water source that is approved in accordance with applicable regulations and permit stipulations to not adversely affect aquatic habitats and biota.

5.8. Fish and Wildlife

5.8.1. Mammals

Mammals that are known to frequent the right-of-way corridor include caribou, moose, brown bear, black bear, furbearers and other small mammals. Wolves, wolverines, lynx, red fox, and marten are generally in remote areas.

Caribou are often present in the Lake Louise Flats, which is located to the north of the proposed pipeline right-of-way, and Slide Mountain-Little Nelchina River areas, a considerable distance from the proposed right-of-way corridor. Calving generally occurs between May 15 and June 10 in the Talkeetna Mountains (ADF&G, 1985a).

Moose are common in the vicinity of the proposed right-of-way corridor and occupy a variety of habitats making seasonal movements for calving, rutting, and wintering. Moose will often spend the winter in the Little Nelchina River drainage and the area to the north of Slide Mountain (Alaska, 1982).

Before construction activities begin, locations of known and occupied bear dens will be obtained from the ADF&G Division of Wildlife Conservation. Should clearing and grubbing be scheduled to occur between November 15 and March 31, the ADF&G and the commissioner of ADNR will recommend methods to minimize disturbances of any nearby bear dens. Reports of unidentified dens will be made within 24-hours to the ADF&G Division of Wildlife Conservation. Construction impacts will be minimized through the use of covered garbage containers, prohibiting storage of food materials, waste handling, sediment controls, and minimizing the extent of disturbance.

Avoiding important salmon streams when fish are present would minimize the displacement of bears from this critical habitat. There will be no facilities visible within 500-feet of fishbearing streams and lakes.

Visual monitoring will detect construction activities that may adversely impact fish or wildlife in the area of the project during construction. The project will be maintained to avoid significant alteration of large mammal movement patterns. The pipeline design and construction techniques will minimize the environmental consequences. Noise, vibrations, equipment movement, and human presence could disturb animals and may alter their travel patterns during construction. A list of mammals that are known to reside in the region that is bisected by the pipeline corridor is presented in Table 5.3.

Table 5.3: List of Mammals Within the Project Area

Common Name	Scientific Name
Common Shrew	Sorex cinereus
Dusky Shrew	Sorex monticolus
Little Brown Bat	Myotis lucifigus
Little Weasel	Mustela nivalis
Short-tailed Weasel (Ermine)	Mustela erminea
Mink	Mustela vison
Marten	Martes Americana
River Otter	Lontra Canadensis
Arctic Ground Squirrel	Spermophilus parryii
Red Squirrel	Tamiasciurus hundsonicus
Northern Flying Squirrel	Glaucomys sabrinus
Beaver	Castor Canadensis
Northern Redbacked Vole	Cleithrionmys rutilus
Meadow Vole	Microtus pennsylvanicus
Muskrat	Ondatra zibethicus
Porcupine	Erethizon dorsatum
Snowshoe Hare	Lepus americanus
Wolverine	Gulo gulo
Wolf	Canis lupus
Coyote	Canis latrans
Lynx	Lynx canadensis

Table 5.3: List of Mammals Within the Project Area (Cont'd)

Common Name	Scientific Name
Red Fox	Vulpes vulpes
Black Bear	Ursus americanus
Brown Bear	Ursus arctos
Caribou	Rangifer tarandus
Moose	Alces alces
Dall's Sheep	Ovis dalli
Mountain Goat	Oreamnos americanus

Sources: Selkregg (1974), de Blainville (1816), Nelson (1884) and Linnaeus (1758).

5.8.2. Avian Species

The Copper River basin supports the largest nesting populations of trumpeter swans in Alaska. Surveys performed in 1995 yielded 3,577 observances of adult trumpeter swans in the region. There are areas of high nesting concentration in the Lake Louise vicinity and in wetlands to the north (Conant et al., 1996). Trumpeter swans are believed to be sensitive to human disturbance on their breeding grounds. Intrusions by humans on nesting grounds have caused temporary and permanent abandonment and movement from breeding or staging areas (Banko, 1960; Bangs et al., 1982; Belanger and Bedard, 1989). Henson and Grant (1991) studied the effects of human disturbance on Trumpeter Swans in the Copper River basin. Trumpeter Swans leave the area in mid-September to early October and concentrate through mid-November in staging areas at Old Man, Crosswind, and Ewan Lakes prior to the fall migration (Alaska, 1982; ADF&G, 1985b; Westlund-Pers., 1999).

Other swans, geese, ducks, and waterfowl may nest within portions of right-of-way corridor during the summer (ADF&G, 1985b). Migration begins during late September and early October.

Bald eagles dwell seasonally in the Copper River Basin. Noise and disturbance can affect the nesting success of bald eagles. A bald eagle nest survey will be conducted prior to pipeline construction activities. Minimum distances will be maintained and project activities will comply with the Bald and Golden Eagle Protection Act. Complete lists of the birds that are known to exist in proximity to the proposed pipeline right-of-way are listed in the environmental report for this project (ANGDA 20005a).

A list of songbirds residing in the project area as identified by the USFWS is presented in the project environmental report (ANGDA 2005a). In addition, the State of Alaska has designated the following as Species of Special Concern: olive-sided flycatcher (Contopus cooperii), grey-cheeked thrush (Caltharus minimus), Townsend's warbler (Dendroica townsendi), and blackpoll (Andres–Pers. Comm., 1999).

5.8.3. Threatened and Endangered Species

No threatened or endangered species (avian or mammal) are known to inhabit the project area; however, some species listed as "sensitive" may be encountered. Alaska sensitive species as defined by BLM are listed in Table 5.4.

Table 5.4: Sensitive Species List

Common Name	Scientific Name
Bureau of Land Management (BLM) Alaska Sensitive Species – Birds	
Black brant	Branta bernicla
Black guillemot	Cepphus grille
Black scoter	Melanitta nigra
Black-tailed godwit	Limosa limosa
Blackpoll warbler	Dendroica striata
Bristle-thighed curlew	Numenius tahitiensis
Buff-breasted sandpiper	Tryngites subruficollis
Dovekie	Alle alle
Dusky Canada goose	Branda Canadensis occidentalis
Gray-cheeked thrush	Catharus mimimus
Harlequin duck	Histrionicus histrionicus
Kittlitz's murrelet	Brachyramphus brevirostris
King eider	Somateria spectabilis
Marbled godwit	Limosa fedoa
Marbled murrelet	Brachyramphus marmoratus
McKay's bunting	Plectrophenax hyperboreus
Northern goshawk (Queen Charlotte)	Accipiter gentilis laingi
Long-tailed duck	Clangula hyemalis
Olive-sided flycatcher	Contopus cooperi borealis
Red knot	Calidris canutus
Red-throated loon	*Gavia stellata*
Surf scoter	*Melanitta perspicllata*
Townsend's warbler	*Dendroica townsendi*
Trumpeter swan	*Cygnus buccinator*
Tule white-fronted goose	*Anser albifrons gambelli*
Yellow-billed loon	*Gavia adamsii*
BLM Alaska Sensitive Species – Mammals	
Canada lynx	*Lynx Canadensis*

Revised April 15, 2004 (see ANGDA, 2005a for a complete list of Threatened and Endangered Species in Alaska)

5.8.4. Fish

Fish species in the rivers and streams along the right-of-way corridor include Chinook, coho, sockeye and pink salmon. Streams being crossed by the pipeline that have salmon are primarily located in the western portion of the route. Salmonids in the rivers and streams and lakes include rainbow trout, Dolly Varden, lake trout, suckers, burbot, whitefish, sculpin and Arctic grayling.

Northern Pike may also be present. Nine-spine and three-spine stickleback are present in the Matanuska Moose Range water bodies.

River and stream crossings will be installed in accordance with conditions stipulated by the ADNR AS 38.35 Right-of-Way Lease, the OHMP, Mining, Land and Water, Temporary Water Use Permits, and the BLM Grant of Right-of-Way. No adverse impacts are anticipated to fish or their habitat within, or adjacent to, the proposed pipeline corridor, or as the result of the construction or maintenance of the buried pipeline.

5.9. Historical and Archeological Preservation

A preliminary survey identified historical and archaeological sites, and cultural resources within the area of the right-of-way corridor. A cultural resources field survey of the area will be conducted prior to applying for a permanent right-of-way lease. ANGDA is committed to complying with state and federal laws that protect such sites. The state right-of-way lease permit and federal right-of-way grant will carry stipulations to further ensure the historical and archaeological sites, and cultural resources are protected and preserved for posterity. Workers will be educated about the land and its people, and will be trained to understand the environmental, social, and cultural values of the people within the project. Personnel will be trained to avoid damaging biological and archaeological resources.

Section 6. Public Outreach

An initial public outreach effort for this project was performed concurrent with the generation of this report. Several meetings and interviews took place at various locations across the public sector. The audience that was thought to best represent the "opinion leaders" of the communities adjacent to the project was included to the extent possible at these meetings. The purpose of these interviews was to ensure that people were fully educated and aware of the project, and to solicit constructive feedback from the community.

The interviews revealed that there are many common questions, or frequently asked questions (FAQ), that people have about the spur line project. The FAQs are summarized below and the answers to some of the questions are contained within this report. However, this project has not developed to the degree necessary to provide accurate responses to many of the FAQs.

A total of 55-persons took part in the outreach that included representation from Palmer, Sutton, Chickaloon, Glacier View, Sheep Mountain, and Glennallen. Each interviewee received an information packet containing articles and maps about the project. They were also directed to the ANGDA web site (http://www.allalaskalng.com/spurline.html) for additional project definition.

The FAQ for this study have been grouped in to the following three categories.

- **How does the natural gas spur line fit into the big picture with the Trans-Canada Pipeline?**
    - Is this spur line necessary if the big pipeline is built?
    - How will it tie into a big pipeline?
    - Is ANGDA a part of the big pipeline effort?
- **What are the specifics of the pipeline and the spur line route?**
    - What are the dimensions of the pipe?
    - What are the safety features and what happens if it ruptures?
    - How deep is it buried?
    - Will ANGDA replant and rehabilitate the route at the time of construction?
    - How will it be maintained?
    - Who owns the gas?
    - How much will the pipeline cost and how is it funded?
    - In choosing the route is ANGDA taking into consideration the impact to the environment and to people?
    - Will access be increased or limited along the route?
- **How will this spur line benefit individuals, communities and the state?**
    - Will this project open up jobs for Alaskans and will this produce any long-term jobs after construction?

- Will part of the gas be used toward hydrogen fuel cell research?
- Will coal bed methane or using coal as fuel sources be necessary if the spur line is built?
- During construction will the workers live in the communities?
- Will communities be able to tie into the pipeline?
- Will this cheaper source of gas be reflected on people's power bills?
- How will the pipeline affect individual communities?
- Will compressor stations be built in every community?

While some vehemently oppose the project, or the selected route for project, in general it was found that most people were very positive about the spur line project. A full report, which includes each of the interviews, is available in the public outreach final report (ANGDA, 2005b).

Section 7. Pipeline Design

7.1. Codes, Criteria, and Standards

The Glennallen to Palmer spur line is considered a gas transmission line and is therefore under the jurisdiction of the U.S. Department of Transportation, Office of Pipeline Safety and must, at a minimum, meet the requirements of 49 CFR 192. Also, an agreement between ADNR and ADOT&PF effective 1994, states that pipelines located within ADOT&PF rights-of-way are managed by ADNR. ADNR requires that pipeline designs meet the requirements of 49 CFR 192.

49 CFR 192 incorporates numerous industry codes and standards by reference, which thus must also be considered during design of the Glennallen to Palmer spur line. In addition, there are other references available that provide valuable guidance for pipeline design. A list of the main codes, criteria, and standards that are applicable to the design are presented below.

All work will be performed in accordance with the following codes, standards, specifications, recommended practices, figures, and/or exhibits, which are part of the project design documents.

ALA - American Lifelines Alliance

- Guidelines for the Design of Buried Steel Pipe, 2001

ANSI – American National Standards Institute

- ASC GPTC Z380.1, American Gas Association Guide for Natural Gas Transmission and Distribution Piping Systems, 2002

API – American Petroleum Institute

- SPEC 5L, Specification for Line Pipe, 2004 Edition.
- SPEC 6D, Specifications for Pipeline Valves, 2002 Edition
- SPEC 6FA, Fire Test for Valves, 1999 Edition
- STD 1102, Steel Pipelines Crossing Railroads and Highways, 2002 Edition
- STD 1104, Standard for Welding Pipelines and Related Facilities, 1999 Edition with 2001 errata

ASME – American Society of Mechanical Engineers

- B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard, 2003 Edition
- B16.9, Factory-Made Wrought Steel Buttwelding Fittings, 2003 Edition
- B16.34, Valves-Flanged, Threaded, and Welding End, 1996 Edition
- B16.49, Factory-Made Wrought Steel Buttwelding Induction Bends for Transportation and Distribution Systems, 2000 Edition
- B31.8, Gas Transmission and Distribution Piping Systems, 2003 Edition

CFR – Code of Federal Regulations

- Title 49, Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards, October 1, 2004

NACE International

- RP0169-2002, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- RP0177-2000, Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
- RP0286-2002, Electrical Isolation of Cathodically Protected Pipelines
- RP0572-2001, Design, Installation, Operation, and Maintenance of Impressed Current Deep Groundbeds

7.2. Class Location

In accordance with 49 CFR 192.5, the majority of the proposed spur line is identified as Class 1 location with a few areas around more heavily populated areas, primarily in the vicinities of Glennallen and Palmer, identified as Classes 2 and 3.

The class designation will dictate the appropriate design factor, F, for steel pipe design and thus directly affect the requirements for the pipe wall thickness.

7.3. Pipeline Wall Thickness

The minimum wall thickness will be calculated in accordance with 49 CFR 192.105. The design wall thickness will vary based on the design factor required by the class location in the particular area where the pipeline is to be installed. Generally, wall-thickness for the 24-inch spur line is expected to vary from 0.562-inch to 1.031-inch based on a preliminary internal operating pressure of 2,500 pounds per square inch.

7.4. Valves

As mandated in 49 CFR 192.179, valves will not be located more than 20-miles apart in Class 1 locations (15-miles for Class 2 and 8-miles for Class 3). The expected valve locations are indicated on the alignment drawings (see Appendix A).

7.5. Corrosion Control Systems

A corrosion control system for buried steel gas pipelines is mandated by 49 CFR 192, Subpart I. The required elements of a corrosion control system are given in 49 CFR 192.455: 1) external protective coating, and 2) CP system. In addition, the regulations require buried pipelines to be electrically isolated from other underground metallic structures, adequately protected against any interference, or “stray”, currents, and designed and installed so as to minimize any adverse effects on existing adjacent underground metallic structures.

7.5.1. Protective Coating

The effectiveness of an external coating system is related to three factors:

1. the resistance of a coating to disbondment,
2. the ability to pass CP current should the coating fail, and
3. the type of surface preparation used with the coating.

State-of-the-art external pipeline coating systems include: fusion bonded epoxy (FBE), liquid epoxy, liquid urethane, and polyethylene. FBE, liquid epoxy, and liquid urethane systems meet all three requirements; they have high adhesive strength and are resistant to disbondment, they conduct CP current should they fail, and they are typically applied over a white or near-white girt-blasted surface. Extruded polyethylene coatings meet the first and third requirements, but they will shield CP current should damage occur. Multi-layer or composite coatings consisting of an FBE inner layer and a polyolefin outer layer with an adhesive between the two layers are also available and have the same strengths and weaknesses as polyethylene systems.

With all coating systems the area of main concern is the field joints where improper surface preparation and application of field coatings has resulted in the formation of external corrosion and/or stress corrosion cracking.

7.5.2. Cathodic Control Systems

CP is a method for reducing corrosion by minimizing the electrical potential between an anode and the pipe (the cathode) through the application of an electrical current, thus protecting the pipeline from outside currents or differences in potential from one section of the pipe to another.

There are two main types of CP systems: galvanic (i.e., sacrificial) or impressed current (see Figure 7.1). Hybrid systems that utilize both sacrificial anodes and impressed current are sometimes used to provide the most efficient and cost-effective design.

Galvanic system

A galvanic CP system makes use of the corrosive potentials between different metals. Without CP, one area of the pipe may exist at a more negative potential than another section, and corrosion occurs. If, however, an object with much more negative potential is placed adjacent to the pipeline and an electrical connection is installed between this object and the pipeline, the object becomes the anode and the entire pipeline becomes the cathode. This results in the object sacrificially corroding, thus protecting the pipeline from corrosion. Which is why a galvanic CP system is typically referred to as a sacrificial anode CP system. The sacrificial anodes are normally made of either magnesium or zinc because of these metals' higher potential compared to steel.

Impressed current system

An impressed current CP system uses the same basic elements as a galvanic CP system, only the pipeline is protected by applying an electrical current to it from the anode using an external power source, thus "driving" the current rather than relying on the difference in potential between the anode and the pipe. The external power source is normally a rectifier that changes input alternating current to the proper direct current power level. The anodes used for impressed current CP systems are typically high-silicon cast iron or graphite.

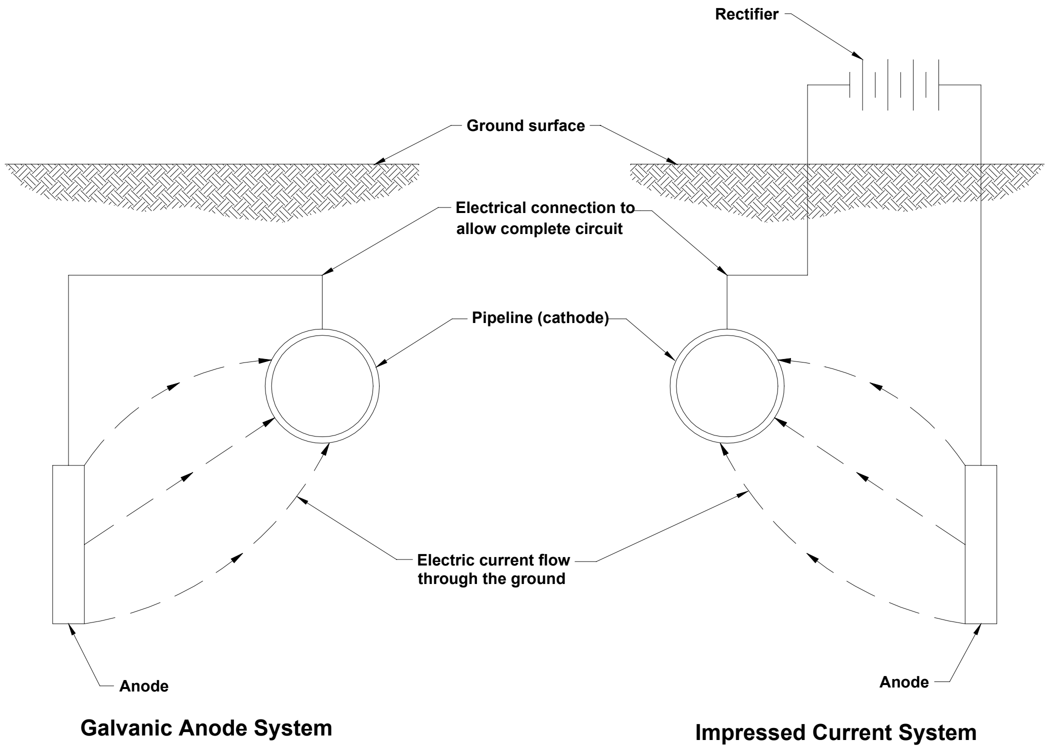

Figure 7.1: Cathodic Protection Systems Schematic

Section 8. Typical Construction Methods

Various methods will be utilized for pipeline construction in order to minimize impacts to the environment while ensuring safe working conditions for the construction crews. The proposed construction methods are proven techniques for economical and safe pipeline construction.

It is anticipated that existing roads will provide the main access for construction, as well as future maintenance activities, thus the need for project specific access roads will be minimal.

8.1. Typical Buried Modes

Buried pipelines are typically installed by excavating a trench, lowering the welded pipeline into the trench, and backfilling, or burying, the pipe. A typical detail of a trenched installation is shown in **Figure 8.1**.

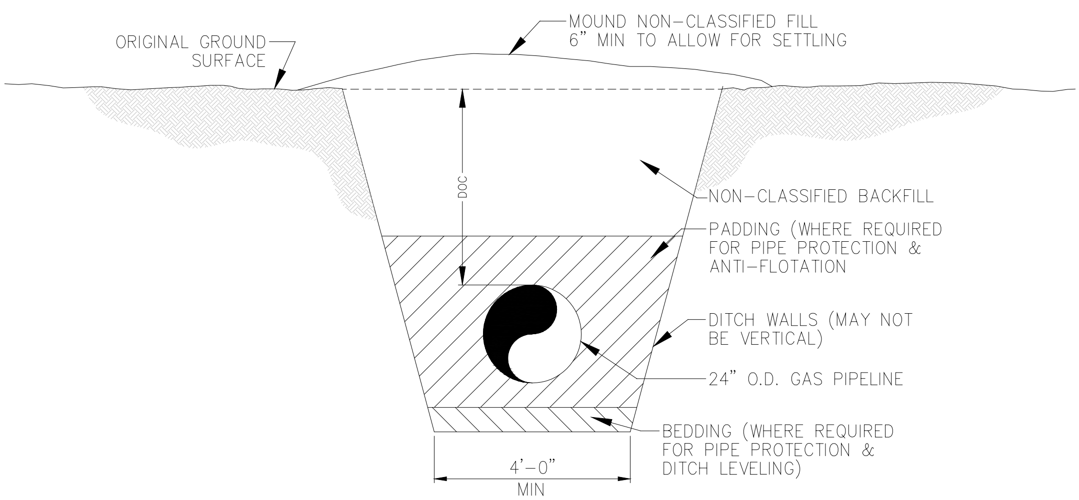

Figure 8.1: Typical Trench Detail

As specified by 40 CFR 192 the minimum DOC for sections of pipe that are designated by code as Class 1 locations is 30-inches, except in areas where consolidated rock is encountered the code allows minimum DOC to 18-inches. Additionally, DOC requirements may increase in specific locations such as stream/road crossings where permit stipulations require additional depth, or sections defined by code as Class 2-4.

In areas where open trenching is determined too intrusive (e.g., sensitive wetlands, river and stream crossings, major road crossings), HDD or boring may be used. While typically more expensive than trenching, these methods may be more economical in some situations. HDD would normally be utilized in environmentally sensitive areas and at river crossings where the length of the crossing and issues with ground water preclude boring. Boring, where entry and exit pits are dug on either side of the crossing and the pipe is installed by auguring beneath the obstacle, often through a temporary casing, is fairly common for road crossings where interruption of traffic flow is not considered feasible.

8.2. Right-of-Way Preparation

One of the first activities that must be completed is preparing the right-of-way to allow for safe and efficient pipeline construction. The actual pipeline right-of-way corridor width for construction will vary depending on activities, topography, construction mode, and property. For all state owned property there will be a 300-ft wide construction right-of-way, but the actual width of affected right-of-way will generally be much less. On all other properties the temporary construction right-of-ways will vary depending on the owner. On each side of a stream crossing the construction right-of-way will need to encompass an area of at least 100-foot wide by 300-foot long.

The right-of-way preparation will include clearing and grubbing of vegetation and then grading of the right-of-way to provide a relatively level working surface from which the main pipeline construction activities can be accomplished. In some areas the installation of a temporary workpad may be required to provide a stable surface. In all cases the grading activities will ensure that normal surface drainage is maintained, that proper erosion control is provided, and that slope stability is controlled at all times.

Once the pipeline has been installed, temporary workpads will be removed to the extent possible and the right-of-way restored to approximately the natural contours. The right-of-way will then be conditioned to promote revegetation and proper measures implemented to prevent erosion. Some locations may require the installation of blocking devices (e.g., berms, gates, bollards, boulders, etc.) to inhibit vehicular traffic.

8.2.1. Winter Construction

A winter construction mode will be used along portions of the alignment that traverse wet or permafrost rich soils. Winter construction will utilize snow/ice workpads, thus simplifying construction in areas that are normally wet, and minimizing damage to the terrain.

A snow/ice workpad is constructed by applying water to compacted snow to provide a solid work surface. The pad is built thick enough to support the weight of construction equipment while protecting the natural ground surface from damage. This construction mode is generally used only in relatively flat areas (i.e. no sizable cross or longitudinal slopes).

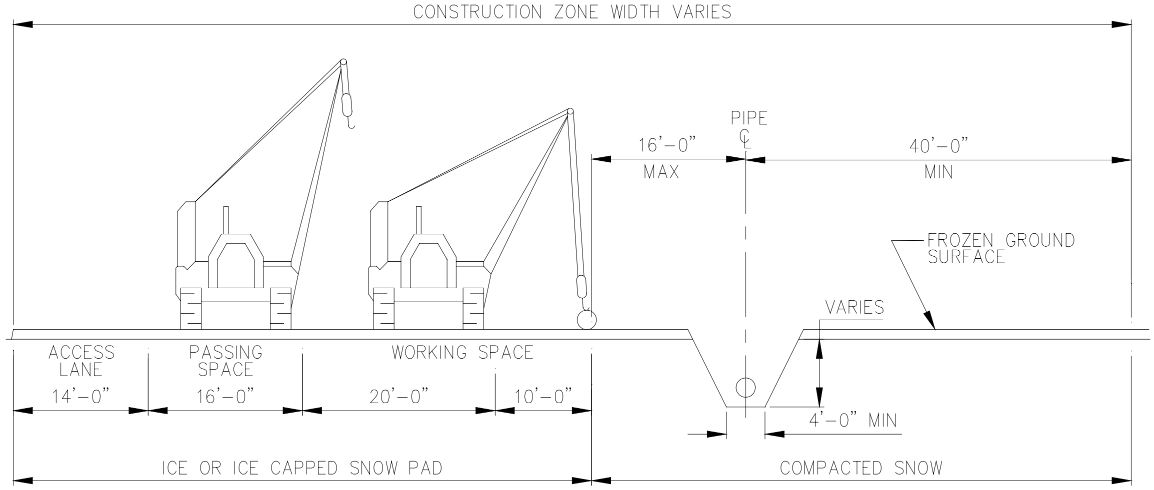

Figure 8.2: Typical Construction from Snow/Ice Workpad

8.2.2. Summer Construction

Wherever possible (i.e. where competent subsurface soils are present), summer construction will be conducted from directly atop the graded right-of-way surface as shown in Figure 8.3 or Figure 8.4. The typical shown in Figure 8.3 is applicable in areas with little to no cross slope, while that shown in Figure 8.4 will apply to areas where the cross slope is more prominent.

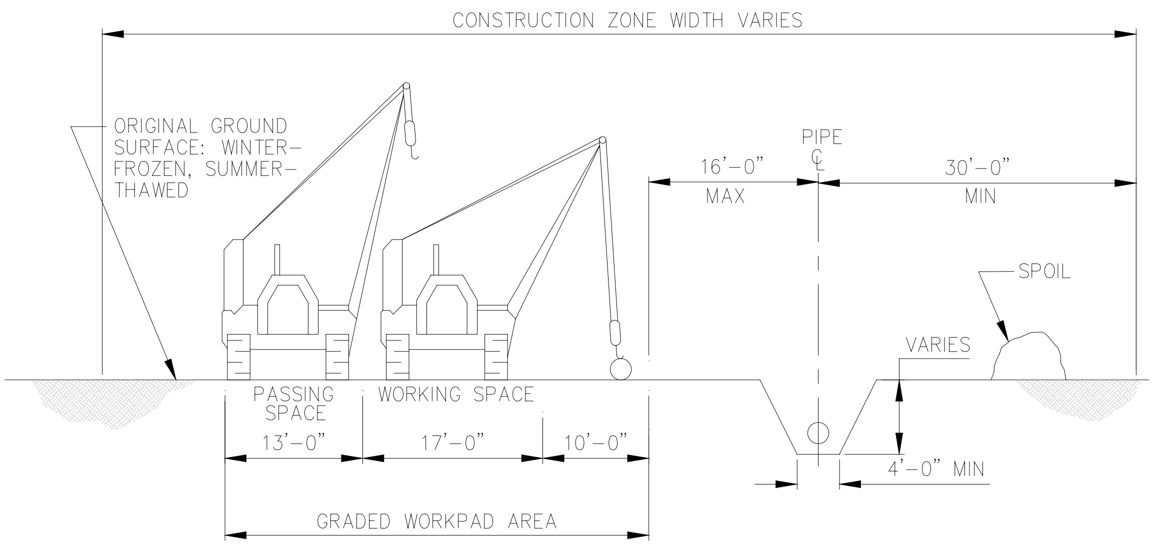

Figure 8.3: Typical Construction from Graded Workpad

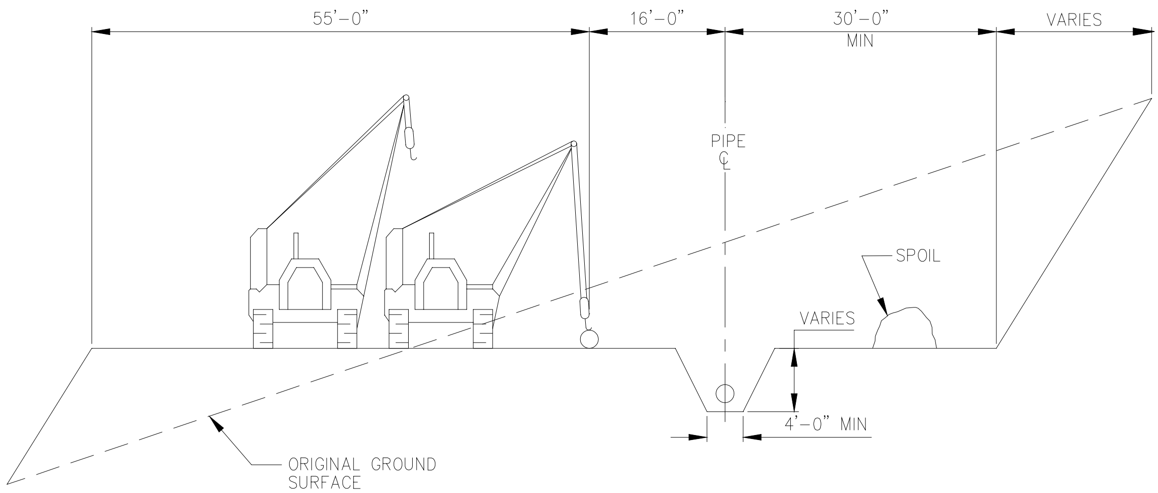

Figure 8.4: Typical Construction from Graded Side Hill Cut

In areas where the subsurface soils do not have adequate strength to properly support the required construction equipment, the preferred construction method may be to work off of construction mats (typically steel frames with wood planks) as shown in Figure 8.5. Use of mats is a fairly common method for pipeline construction.

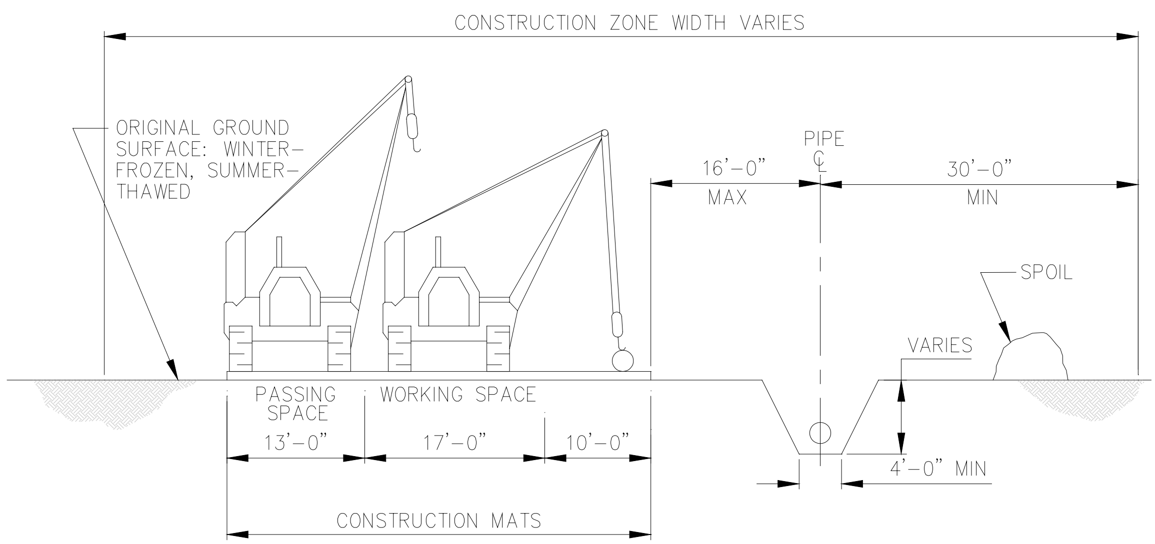

Figure 8.5: Typical Construction from Mat on Graded Workpad

Depending on the actual subsurface conditions encountered, there may be a need to construct a gravel workpad. The use of such workpads will be minimized to the extent possible.

8.3. Crossings

As is typical for cross-country pipelines, the proposed alignment crosses numerous streams and rivers, roadways, and utilities. In addition, the proposed alignment will cross beneath the railroad near the terminus of the line.

8.3.1. Major Roads and Railroads

Crossings of major roads and railroads will be designed in accordance with the latest edition of API RP 1102, *Steel Pipelines Crossing Railroads and Highways*. The pipeline will be installed uncased wherever possible. An increase in the wall thickness of the pipe will be necessary under all major roads and railroads in accordance with the requirements of ASME B31.8, which specifies a different design factor in these locations. A typical detail for a major road crossing is shown in Figure 8.6. In general, a typical railroad crossing would be essentially the same as that for a major road. Most, if not all, major roads and railroads crossings will be installed by boring. Traffic delays are not expected during the boring process.

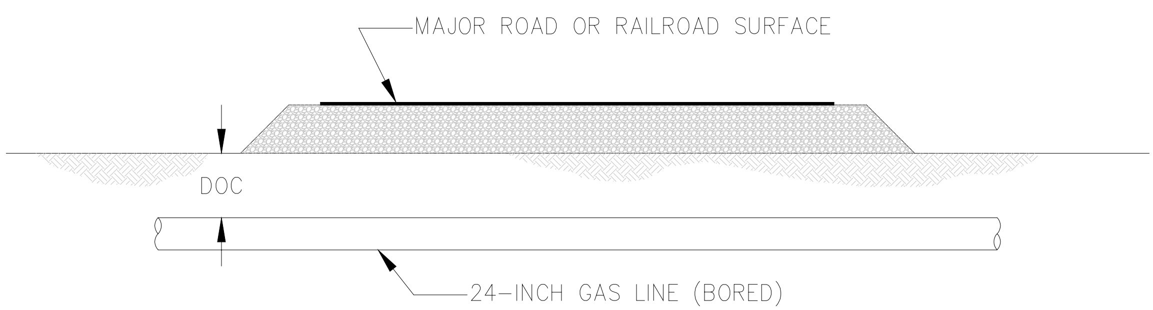

Figure 8.6: Typical Major Road/Railroad Crossing

Per API RP 1102, the minimum required DOC for roads is 4-ft below toe or ditch bottom, and for railroads is 6-ft below toe or ditch bottom. These criteria will apply unless additional depth is required per the lease stipulations for the project in those areas.

8.3.2. Minor Roads and Driveways

The pipeline will be installed by the standard open-cut trench method at most minor roads and driveways encountered along the alignment. In some cases access may be temporarily interrupted during construction. The final driving surface will be restored to equal or better condition than original and may require maintenance in subsequent years. In some cases, the pipeline may be installed beneath minor roads and driveways by boring. A typical minor road crossing based on the open-cut construction method is shown in Figure 8.7.

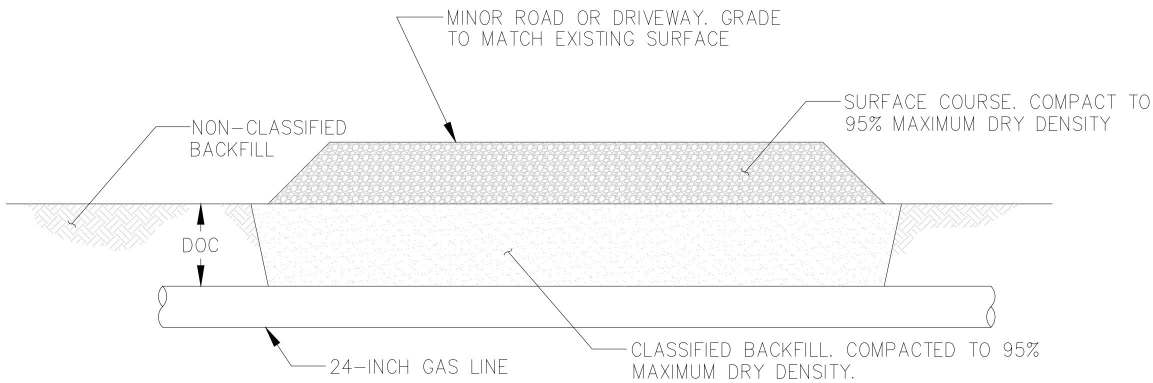

Figure 8.7: Typical Minor Road/Driveway Crossing

Unless permit stipulations for the right-of–way lease dictate a deeper burial depth the standard requirements as defined by 49 CFR 192 will apply for minor roads and driveway crossings.

8.3.3. Rivers and Streams

A total of 81 crossings of rivers and streams have been identified for this project. It is expected that the pipeline will be installed at most of these crossings by open-cut trenching. However, the requirement to cross some of the streams using HDD is expected. Generally if a stream is anadromous the possibility of an HDD required crossing exists. However, in some cases performing these cuts during winter months will reduce damage to the surrounding vegetation and allow excavation to occur when little to no running water is present, thus reducing the sedimentation impact on the stream. Until further information can be collected that may identify if an anadromous stream can be crossed using the open cut trench technique during the winter months, it will be assumed that all such streams will be crossed using HDD. Existing data shows that 17 anadromous stream crossings exist on this project (see Table 5.1).

According to the OHMP there are no requirements for increasing the depth of burial beyond that specified by 49 CFR 192. However, while it is not anticipated that any of the stream or river crossings will be susceptible to large amounts of scour, each crossing will be evaluated once field investigation have been completed and the depth of burial adjusted as necessary. Crossings requiring burial depths significantly greater than the typical depth will likely be installed by HDD. A schematic of a typical stream crossing is shown in Figure 8.8.

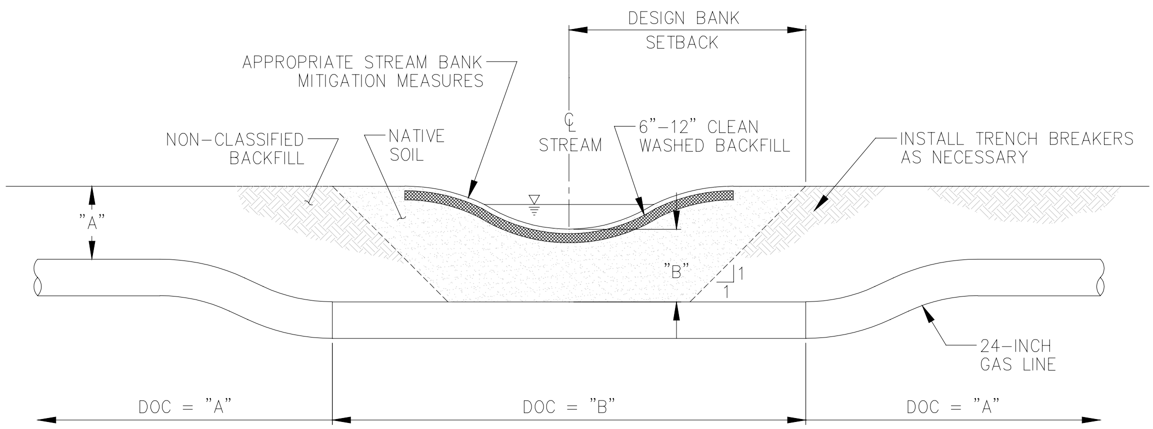

Figure 8.8: Typical Stream Crossing

8.3.4. Existing Utilities

Existing utilities such as water, power, and telecommunications along the pipeline alignment will be identified to the maximum extent possible during the design phase of the project and will be avoided whenever possible. However, in some cases rerouting the pipeline to avoid existing utilities may not be feasible. In these cases, rerouting of the utilities may be required. Any such reroutes will require the cooperation of the utility owner and costs associated will be born by the project.

8.4. Traffic Impedances

Except where construction equipment, supplies, and crews are being transported, there are not expected to be traffic interferences along the major roads for this project. However, at many of the smaller road and driveway crossings to be installed by open cut there may be temporary delays.

Section 9. Construction

The ANGDA construction scheduling scenario is driven by the earliest, and expected, start date. Project management and scheduling is based on the concept of pre-building the Palmer to Glennallen spur line to: (1) connect to the proposed Alaska Gasline Port Authority (Port Authority) pipeline that will pass through Glennallen enroute to Valdez, (2) tie-in to the proposed pipeline from the North Slope to Chicago, or (3) build pipeline from Glennallen to either Prudhoe Bay or Point Thompson. See the timeline scenarios as provided by ANGDA in Appendix C.

To develop a reasonable estimate and schedule for the spur line project it is important to be aware of how this study envisions the implementation of construction and what assumptions were necessary. Construction was divided into two seasons, winter and summer.

<u>Winter Construction</u>: Construction of the spur line between MP 0 and MP 68.5 will occur during the winter season due to its large concentration of ice rich soils, wetlands, and gently sloped terrain.

<u>Summer Construction</u>: A summer construction season will be used to construct the remainder of the route, from MP 68.5 to MP 147.9. This section of the route provides terrain that is mountainous and contains more competent and rocky soils. There will also be a considerable amount of workpad grading required in certain areas in order to accommodate the daily transport of equipment and personnel to the site.

A detailed summary of the route description is provided earlier in this report (see Section 4.1).

9.1. Schedule

The duration of construction for the project is expected to encompass portions of three years. Though the bulk of the construction will be performed within the first two years, with the third year being primarily for refurbishment of the affected environments. Should the construction commence in the fall of 2006 as planned (see ANGDA Timeline Scenario in Appendix C), the pipeline could be ready for service as early as the summer of 2008.

<u>2006</u>

The first summer prior to pipeline construction will be dedicated to pre-construction of the necessary facilities. Some of the anticipated pre-construction accomplishments include:

- Mobilization of Owner/Agent quality control and project management.
- Mobilization of construction equipment and temporary facilities.
- Opening of gravel pits; mining and processing of material for pads, access roads and bedding/padding material.
- Construction of gravel pads warehouses, maintenance shops, and material lay-down sites.
- Mobilization and construction of temporary housing facilities for pipeline construction personnel.
- Purchase and transportation of non-owner supplied materials and consumables.

- Transportation of owner supplied materials from owner's storage yards to the staging areas established for each spread.
- Mobilization of pipeline construction equipment and personnel as required for start of pipeline construction at the beginning of year two. Personnel will be indoctrinated, trained in both environmental and safety issues

Existing facilities/infrastructure will be utilized to the extent that it is in place. The pre-construction personnel will, by necessity, utilize all available facilities/infrastructure.

2007

Winter construction of pipeline from MP 0 to MP 68.5 will begin in January. Construction, including hydrotesting, will be complete by the end of May. Re-vegetation of the affected right-of-way will be performed during the summer months.

Summer construction of pipeline from MP 68.5 to MP 147.9 will begin by June. Construction, including hydrotesting, will be complete by the middle of October. The pipeline will then be turned over to the Owners for start-up operations. Re-vegetation will commence during the summer of 2007, but will not be completed until 2008.

2008

Completion of re-vegetation for the summer spread will be during the summer of 2008. Any mediation requirements of previous work will also be accomplished in year three. Note, that mediation efforts will not cease after 2008, rather they will continue on a smaller scale, throughout the life of the pipeline.

9.2. Cost Estimate

The budget level cost estimate that has been established for construction of the 148-mile spur line from Glennallen to Enstar's 20-inch pipeline southwest of Palmer is $361.8 million, expressed in year 2005 dollars. As directed by ANGDA, allowances for construction camps have not been included in this estimate. Table 9.1 summarizes the project construction costs, and supporting cost estimate worksheets are included in Appendix B.

Table 9.1: Construction Cost Summary

Description		Cost X 1000
Summer Construction Costs		
Direct Contractor Construction Costs		$44,826
Indirect Contractor Construction Costs		$21,879
Sub-total Contractor Construction Costs		**$66,705**
Contractor Markup (20% overhead and profit)		$13,341
Total Pipeline Contractor Cost - Summer		**$80,046**
Winter Construction Costs		
Direct Contractor Construction Costs		$42,191
Indirect Contractor Construction Costs		$20,194
Sub-total Contractor Construction Costs		**$62,385**
Contractor Markup (20% overhead and profit)		$12,477
Total Pipeline Contractor Cost - Winter		**$74,862**
Material Costs		
Material (includes freight)		$126,171
Total Material Costs		**$126,171**
Miscellaneous Pipeline Construction Costs (not included above)	**Unit Cost**	
Cathodic system protection (allowance, $18,000 per mile)	$18,000	$2,660
SCADA and Communications (allowance, $3.00 per foot)	$3	$2,341
Medical Facility (ambulance, eqipment, facility, training) $125K ea per ANGDA	$125	$250
Unload, haul and stockpile pipe & materials, based on pipe weight per cwt @4.30	547,011	$4,384
Gravel Royality @ 0.75 per cyd	418,704	$628
Air freight supplies, etc @ $25.00 per cwt	940	$50
Open pits, mine and process material, cubic yards at $9.50 per cubic yd.	200,000	$3,325
HDD Stream Crossings (allowance, $1,075/ft winter ($950/ft summer), 17-total)	varies	$14,873
Total Miscellaneous Costs		**$28,511**
Project Indirect Costs	**Cost per ft.**	
Detailed Engineering	$19.28	$15,046
Surveying	$3.00	$2,341
Permitting	$3.74	$2,919
Quality Control	$11.61	$9,060
Project Management, etc.	$25.48	$19,884
Purchasing and expediting	$3.74	$2,919
Total Project Indirect Costs		**$52,169**
Total Pipeline Costs		**$361,758**

This estimate is based primarily on the information that is presented on the alignment sheets (see Appendix A). The alignment sheets identify the route location, material locations, stream, creek, and river locations, secondary roads, trails and highway locations. The alignment sheets also contain contour lines and elevation changes. However, minimal information regarding items such as fish streams, vegetation, and general terrain analysis (i.e. locations and magnitudes of side hill cuts) was not available thus assumptions were made to account for these areas.

Due to lack of sufficient field visits, items such as water sources for hydrostatic tests and discharge have been discussed in general terms, but not identified specifically. Actual locations of required temporary project facilities and material lay-down sites have been discussed, but not yet located. An SWPPP has not been established and is not included in this cost estimate. Furthermore, the estimate has not benefited from field reconnaissance, and therefore the alignment sheets have been relied upon heavily to develop this estimate.

Based on the limited information that is available at this time this estimate is considered to be a Budget (Level 0) type estimate whose accuracy is +/- 30%. This estimate is intended only to provide detail of the expected project costs and respond to question number 37 of the right-of-way lease application. For further definition of estimate levels refer to the *Estimate Criterion* document in Appendix B.

The estimate has been developed based on the schedule that is discussed in the previous section (Section 9.1). Estimates for pipeline construction work have assumed the crew-up concept and were developed for each pipeline construction activity. The current prevailing costs have been compiled for labor, equipment, and material/consumables for each construction activity and are summarized in Appendix B. There is also a summary for the expected production rate and duration for each crew activity. Additional cost summaries that are based on past cost data are also summarized.

Estimate Assumptions:

The budget cost estimate is based on the following assumptions:

Material and class:

- 24-inch diameter x 0.521-inch wall thickness
- API specification 5L X80 steel pipe with FBE coating
- Location Class l
- MAOP of 2500 psi
- ANSI 1500
- Manufactured pipe lengths were assumed an average length 58-feet
- The pipe will be protected by 18-20 mil FBE coating
- Valves and fittings shall be weld end underground installation with 6-inch by pass with blow-down
- Temperature rating will be determined.

Winter/Summer Construction:

Summer construction utilizes the same crews that are required for winter construction, and includes additional crews for right-of-way grading, clearing, and preparation. For this estimate, crews were included to perform the following tasks:

- Survey pipeline right-of-way route; this crew will survey the centerline and right-of-way limits from reference points previously established during the initial route survey.
- Right-of-way clearing; the right-of-way will contain some brush and small trees that will be cleared and chipped.
- Preparation of the right-of-way; the right-of-way will require some grading to allow for construction activities.
- Construction of an ice/snow pad; Ice/snow pad will be constructed in all environmental sensitive areas that are subject to degradation should the original earth require such action.
- Maintenance of the snow/ice work pad; will be required full time during its use.
- Machine ditch, Rocksaw and/or backhoe.
- Drill/blast and backhoe ditch; mode will be utilized where the Rocksaw is not proficient.
- Load, haul and string pipe is assumed to be an average haul distance of 15-miles from previous stockpiled lay-down sites.
- Bend and set-up, assume pipe bending can be accomplished during the winter months. May need some research for X-80 pipe
- Weld procedures, train and test welders. The Crutcher-Rolf-Cummings (more commonly referred to as CSC) automatic welding system (or equivalent) will be used for all mainline welds. Tie-in welds will utilize the micro wire welding process.
- Ultrasonic Testing (UT) mainline and x-ray tie-ins. All mainline welds will be qualified by the UT method and generally all tie-in welds will be qualified by the radiographic method.
- Weld repair methods must be established. Assumed weld repair by micro wire procedures.
- Coat welds and repair holidays, assumed weld joints will be coated with a brush-on type of epoxy coating that has been utilized and proved successful. Repairs to holidays will be made by the same brush on epoxy coating.
- Bedding padding, assumed that a certain amount of bedding and padding import material will be required.
- Lower-in will be accomplished by conventional pipeline construction methods.
- Tie-ins will be accomplished by the micro wire welding process.
- Backfill and cleanup will be accomplished by conventional pipeline construction methods.
- Fabricate valve assemblies; welding will be accomplished by the micro wire process. The complete assembly will be fabricated and shipped to the field for installation
- Install valve vault, controls & house, assumed access to valves required.

- Install valve assembly, welding will be accomplished by the micro wire process.
- Excavate and install streams, creeks and rivers. Assumed that all non-anadromous waterways will be crossed via the open cut method.
- HDD installations for streams, creeks and rivers. Assumed that all anadromous waterways will be crossed via the open cut method. Per limited information there is assumed to be 17 such crossings (14 in the summer construction section and 3 in the winter construction section). Note that winter HDD crossings will require additional equipment such as shelters and other items.
- Road crossing, open-cut. All road crossings as practical will be installed by the open cut method.
- Road crossings, bored. All major highways and byways will be crossed utilizing the road bore method.
- Clean, test and dry pipeline. All pipeline cleaning, testing, and drying will be performed in the summer and fall months before deep frost penetration.
- Final tie-ins will be accomplished after all pipeline work is complete.
- Erosion control & seeding will be accomplished in the summer months as close to the finished work as possible.

The following work is not included in the pipeline construction crew sheets, however, cost related activities are included in the cost summaries based on accumulated costs from past cost data. This cost data includes the following:

Miscellaneous Costs:

- Mine, process gravel & pad material
- Gravel pads for pipeline material lay-down sites.
- Cathodic Protection
- SCADA and communications
- Camp mobilization, installation, operation, demobilization and rental fee
- Unload, haul and stockpile pipe & materials
- Gravel royalties
- Airfreight supplies, etc.

Detailed Engineering Costs:

- Detailed Engineering
- Surveying
- Permitting
- Quality Control
- Project Management, etc.

- Purchasing and expediting

Items addressed but no costs included:

- Project Management
- Cost of Money
- Contingency allowance
- Inflation
- Environmental Constraints

Items not considered for this report:

- Compressor station
- Side taps, border station, etc.

9.3. Materials

The major material requirements for this project are as follows:

- 780,384-feet, plus 2.5% allowance for terrain elevation changes and waste, of 24-inch x 0.521 wt, X-80 steel pipe (FBE coated).
- 7 each Valve assemblies remote control
- 7 each Valve vaults and housing
- Brush on material for weld joint coating and repairs.

Based on the cost estimate from the previous section (see Table 9.1) the expected costs for all pipeline materials for this project, including freight, will be slightly more than $126 million.

9.3.1. Long Lead Items

Long lead items for the construction of the spur line are:

- 24-inch x 0.521 wt, X-80 steel pipe (FBE coated)
- Valve and fittings for valve assemblies.

Bends will be made as needed in Alaska thus eliminating the need for prefabrication of factory bends.

9.3.2. Mining Sites

A brief study was conducted for the purpose of identifying potential material sites, both existing and possibly new areas. This study was limited in scope and detail due to the following:

- Aerial photography was not available, nor was any field reconnaissance authorized for this conceptual study.
- Only public information available from the State of Alaska Geological and Geophysical Survey and the ADOT&PF was available.

- Available mapping was restricted to USGS 1:63,360 topographic maps.

This work effort should be viewed as a preliminary assessment of exploration targets for further study only. The material sites identified in Table 9.2 represent a compilation of currently available information. The site locations are depicted on the alignment sheets (see Appendix A).

Table 9.2: Material Exploration Sites

Site No.	Approx MP	Material Description	Site No.	Approx MP	Material Description
1	-	Glaciofluvial sand and gravel	11	64.2	Silty, sandy, gravel (till)
2A	-	Glaciofluvial sand and gravel	13	69.1	Bedrock
2B	15.6	Limited quantity sand and gravel, river terrace	14	77.7	Floodplain sand and gravel
3	16.7	Silty, sandy gravel (till)	15	83.8	Bedrock or till
4	-	Silty, sandy gravel (till)	16	91.1	Bedrock
4A	20.3	Silty, sandy gravel (till)	17	96.6	Limited floodplain, silty sand and gravel
4B	22.7	Silty, sandy gravel	18	99.8	Limited floodplain, silty sand and gravel
4C	23.9	Silty, sandy gravel (moraine)	19	103.8	Floodplain, sand and gravel
4D	33.6	Silty, sandy gravel (moraine)	20	110.2	Bedrock or till/glaciofluvial
4E	36.8	Silty, sandy gravel (moraine)	21	126.3	Alluvial fan sand and gravel
5	-	Floodplain (braided) sand and gravel	22	126.9	Coal mine tailings
5A	38.7	Silty, sandy gravel	23	133.3	Sand and gravel
6	42.7	Glaciofluvial sand and gravel	24	134.2	Sand and gravel
7	-	Glaciofluvial sand and gravel	25	134.7	Sand and gravel
8	-	Glaciofluvial sand and gravel	26	137.1	Sand and gravel
7A	44.2	Esker and kame, sand and gravel	27	139.8	Sand and gravel
7B	44.5	Esker and kame, sand and gravel	28	140.5	Sand and gravel
9	47.0	Sand and gravel	29	141.2	Sand and gravel
9A	50.6	Limited quantity sand and gravel, small river terrace	30	142.9	Sand and gravel
10	55.5	Silty, sandy gravel (till)			

It is expected that at least half of the sites listed in Table 9.2 will be eliminated from consideration after a more complete study can be performed. Final evaluation and selection of material sites must be conducted using aerial photo analysis, field reconnaissance, and soils investigations. Therefore, final material site selection must be accomplished during a subsequent study.

The alignment sheets in Appendix A also delineate some additional locations that reflect potential materials sites along the route that have been, or currently are being, used by the State of Alaska for mining materials. The validity and legal uses of these sites will need to be verified on a case-by-case basis when more information is obtainable.

9.3.3. Material and Equipment Storage

With the written approval of the commissioner of ADNR machinery, equipment, tools, materials, structures, mainline pipe, other materials, and construction equipment will be stored on the right-of-way or in areas leased from landowners along the route.

9.4. Logistics

Materials, equipment, and crews transported to the project construction sites will use existing infrastructure, including the Glenn Highway and other public roads. Temporary access points will likely be required during construction but long-term access will not be developed. Existing roads, airstrips, ports, and other transportation facilities in Anchorage, Fairbanks, Glennallen and Palmer will be used to support the pipeline construction and operation. Equipment and materials will be stored at private storage sites during construction. Existing commercial and private borrow sites may be used to dispose of excavation spoil and for production of backfill materials. Pipeline construction equipment will include hydroaxes, bulldozers, graders, trenchers, excavators, pipe layers (i.e., sidebooms), and various other vehicles (e.g. tractor-trailer rigs, dump trucks, etc).

9.5. Access

No facilities or operations may be located in manner that blocks public access to, or along, navigable and public waters (AS 38.05.965 (13) and (17)). Site specific plans will be developed to optimize site security while allowing normal access to the construction right-of-way. The plans will be flexible to accommodate changes during construction activities. Temporary access controls, in compliance with federal and state regulations, will be used to protect the pipeline and construction operations from vandalism, theft, and other inappropriate activities. For public safety and security for the pipeline, equipment, and materials, signs, warning tape, construction barricades, equipment and/or material will be placed at access points to the right-of-way corridor during activities such as excavation, welding, and backfill. These precautions will protect the public from dangers during construction activities and at construction sites.

Access will generally remain unobstructed during pipeline operations. However, access into the backcountry for hunting, recreation, timber, coal mining and settlement may be temporarily interrupted. Gates may be constructed at access points and fencing may be required around portions of the pipeline. The pipeline will be buried and access will not be an operational concern.

Section 10. Quality Assurance

A complete quality assurance (QA) plan will be developed for the project when the definition of the project has been finalized. Included as a part of the QA plan will be steps to ensure that quality control, inspection and testing plans have been developed and are abided by.

10.1. Quality Control Plan

The objective of a project Quality Control Plan is to ensure management and regulatory authorities that project activities (e.g., engineering, materials procurement, etc.) are in compliance with project requirements, especially federal and state stipulations. Within these stipulations, references may be made to other requirements (e.g., 49 CFR 192), which in turn dictate design, and construction requirements.

The basic precept of a Quality Control Plan is that each group takes responsibility for the quality of the work they perform. Individuals responsible for verifying conformance will be independent of those responsible for performing the work.

Quality control applies to all phases of the work from the beginning to end. For each phase or component of the work, the quality control process will require identification of all technical requirements, description of the process for achieving those technical requirements, how performances relative to those requirements will be measured and how changes in technical requirements will be managed. An important part of this process will be to identify how it will be verified that processes have been complied with and technical requirements have been met.

The following section discusses the overall scope of quality control activities, however the organization and responsibilities may not be exactly as described.

A Quality Control Plan is developed to ensure compliance with environmental and technical stipulations, and is normally contained in a project quality manual. This manual should describe the quality processes as they relate to each part of the organization and should be revised as necessary to assure compliance with applicable federal, state, and local regulations. The major areas that would be covered by the manual and/or accompanying procedural guides are:

- Responsibilities and organization
- Manual Control
- Quality Training and Orientation
- Work Process Description and Key Requirements
- Design Control
- Drawing Control
- Document Control
- Procurement
- Vendor Quality Program Requirements
- Auditing and Auditor Training

- Inspection
- Regulatory and Governmental Interfaces
- Control of Measuring and Test Equipment
- Handling, Storage, Packaging and Shipping
- Inspection, Test and Operating Status
- Nonconformance Reporting and Corrective Action
- Quality-Related Records
- Welder Certification
- NDE Certification

Procedures describing implementation of each of these areas would be developed to identify appropriate management controls to be applied to work activities, organizations/individuals responsible for implementing work activities, and organizational interfaces to carry out the prescribed activities.

10.2. Inspection Plan

The objective of a project Inspection Plan is to ensure that construction materials meet, and activities are performed in accordance with, design drawings and specifications, as well as any stipulations dictated by the agreement and grant of right-of-way. There will be inspection activities associated with various phases of the project including: material procurement, fabrication, and construction. There may also be inspection activities required during initial start-up.

Inspections may be conducted in conjunction with the following activities:

<u>Procurement and Fabrication</u>

- Pipe manufacturing and coating
- Mainline valve selection and purchase
- Equipment selection and purchase
- Shop fabrication

<u>Pipeline Construction</u>

- Material site processing
- Material handling and storage
- Pipe delivery to storage yards
- Access road and work pad construction
- Ditching
- Blasting

- Road crossing construction
- Welding
- Girth Weld Coating
- Padding placement
- Lowering-in
- Backfilling
- Mainline valve installation
- Hydrostatic/Pressure Testing
- Pipe bending

Facilities Construction

- Civil work
- Foundation work
- Equipment installation
- Electrical/Control systems installation and checkout
- Mechanical start-up and commissioning

Records documenting all inspection activities quality records and will be subject to requirements identified in the Quality Control Plan.

10.3. Testing Plan

The objective of a project hydrostatic testing plan is to: define criteria for test pressure limitations, durations and siting of test sections; describe the testing methods planned; and a step-by-step procedure for implementing the test. Alternate test methods and contingency plans are normally included and environmental considerations are noted in applicable sections. The plan will also include: descriptions of dewatering equipment, locations of test segments, identification of sampling ports, and catalogues of water sources.

The criteria requirements that must be addressed in the hydrostatic testing plan include:

- minimum and maximum test pressure,
- test period, and
- length of test sections.

The test procedures developed must address the steps necessary to complete the hydrostatic testing requirements. These steps include:

- internal cleaning and inspection,
- installation of test equipment and instrumentation
- line fill,

- pressurization,
- stabilization,
- dewatering, and
- drying.

In addition, the hydrostatic testing plan will contain information regarding water source and disposal, a contingency plan in the event of a leak or rupture, and possibly present alternative testing techniques to address special conditions, such as testing in the winter, which may require the addition of freeze-protection to the test medium.

Section 11.Financing Requirements

The financial requirements for the ANGDA spur line project have been identified in a September 2004 report that was developed by First Southwest Company (FSC). For further detail refer to the *Financial Plan for the Cook Inlet Spurline* (ANGDA, 2004b) report.

Section 12.References

ADF&G. 1985a. Alaska Habitat Management Guide. Southcentral Region: Reference Maps. Vol. I: Distribution and Human Use of Mammals. ADF&G. Anchorage, Alaska.

ADF&G. 1985b, Alaska Habitat Management Guide. Southcentral Region: Reference Maps. Vol. II: Distribution and Human Use of Birds. ADF&G. Anchorage, Alaska.

Alaska (Alaska, Governors Agency Advisory Committee on Leasing). 1982. A Social, Economic, and Environmental Analysis of the Proposed Middle Tanana Basin and Copper River Basin Oil and Gas Lease Sale No. 37. Juneau, Alaska.

ANGDA. 2004a. *24-Inch Spur Line from Glennallen to Palmer: Conceptual Alignment and Budget Level Cost Estimate*. Prepared by Michael Baker Jr., Inc.

ANGDA. 2004b. *Financial Plan for the Cook Inlet Spurline*. Prepared by First Southwest Company.

ANGA. 2004c. *ANGDA Spur Line Report on Utility Regulation*. Prepared by Steve Pratt.

ANGDA. 2004d. *Cook Inlet Gas Spur Line Project Right-of-Way and Permitting Issues.* Prepared by Land Field Services, Inc.

ANGDA. 2005a. *Spur Gas Pipeline Glennallen to Palmer Environmental Report*. Lynx Enterprises, Inc. (of ASRC Energy Services).

ANGDA. 2005b. *Public Outreach Report – Interviews of Local Opinion Leaders / Cook Inlet Spur Line*. Prepared by Ruth Adams.

ANGDA. 2005c. *Glennallen to Palmer Spur Line Alignment/Lands Report*. Prepared by ENSTAR.

ANGDA. 2005d. *Transport of North Slope Natural Gas to Tidewater – Key Design Considerations - Report.* Prepared by Michael Baker Jr., Inc.

Bangs, Edward E., Bailey, Theodore N. 1982. *Moose movement and distribution in response to winter seismological exploration on the Kenai National Wildlife Refuge, Alaska*. U.S. Fish and Wildlife Service.

Banko, Winston E. 1960. The trumpeter swan; its history, habits, and population in the United States. U.S. Fish and Wildlife Service.

Belanger, L. and J. Bedard. 1989. *Responses of staging greater snow geese to human Disturbance*. Journal of Wildlife Management 53(3):713-719.

Contant, Bruce. 1996. Alaska Productivity Surveys of Geese, Swans, and Brant. Juneau, Alaska: Migratory Bird Management, U.S. Fish and Wildlife Service.

Cowardin, L.M., V. Carter, F.C. Golet and E.T. LaRoe. 1979. *Classification of wetlands and deepwater habitats of the United States*. Office of Biological Services and U.S. Fish and Wildlife Service [FWS/OBS-79/31].

Heeon and Grant. 1991

Selkegg, Lidia. 1974. Alaska Regional Profiles

State of Alaska. 1999. *Copper River Basin Area Plan.* Alaska Department of Natural Resources and Division of Oil & Gas http://www.dnr.state.ak.us/mlw/planning/areaplans/copper/index.cfm

Westlund-Pers. 1999.

Appendix A – Preliminary Alignment Drawings

Appendix B - Cost Estimate

Appendix C – Construction Schedule